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CONTRIBUTIONS

TO

PRACTICAL SURGERY.

CONTRIBUTIONS

TO

PRACTICAL SURGERY.

BY

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PREFACE.

SEVERAL of the following essays appeared originally in the *American Journal of the Medical Sciences.* Those upon the occurrence of Non-union after Fractures, and the Statistical Results of Operations upon the larger Arteries, and upon Fractures and Amputations, have met with favorable notice abroad as well as at home, and have been freely made use of by later writers, in some instances with but slight notice of their sources. The statistical method of investigation at the time of their publication was something of a novelty in surgery, and was looked upon with suspicion, but it is now everywhere accepted as one of value in all departments of research. Much labor was expended in the collection of these statistics and in their careful analysis. They are now reprinted for reference and comparison with more recent investigations.

There have been added a paper on Compound Fractures, a large amount of new material on the Occurrence of False Joints, and numerous Clinical Histories drawn from a hospital service of thirty years, which, it is hoped, may not prove uninteresting to the practitioner.

1534 LOCUST ST., PHILADELPHIA,
July 1st, 1873.

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CONTRIBUTIONS

TO

PRACTICAL SURGERY.

ON THE OCCURRENCE OF NON-UNION AFTER FRACTURES· ITS CAUSES AND TREATMENT.

FEW subjects in surgery possess so much interest and importance, or have more justly exercised the pens of writers, than injuries to the bones with their consequences, and yet we find at this day many points in relation to them demanding further investigation. Of this kind, is that state of parts following upon a solution of continuity in the bony structure, termed ununited fracture, the causes, pathology, treatment, etc., of which, are all matters upon which very indefinite ideas are held by the great mass of practitioners. Having had my attention particularly drawn to the subject, and finding the great contrariety of opinion that existed among writers and practitioners in regard to the best mode of treatment of this state of parts, I collected together a table of as many of the more complete cases as I found recorded in the works within my reach, with a view to their analysis, for the purpose of satisfying myself on this important point.

The tables, together with the analysis made of them, have been very carefully drawn out, and believing them to possess interest, I have ventured to arrange them for publication, in connection with other matter on the subject with which their analysis, and my reading and personal observations, have furnished me. The single cases which at long intervals meet the eye of the reader, like the results of treatment given by practitioners from recollection alone, not unfrequently mislead us, and I am inclined to think, were the scattered facts which we find recorded in our science more frequently collected together in tabular forms, compared, and analyzed, that we would be furnished with much valuable information of which we are now deprived. I am well aware that many objections have been urged to this mode of arriving at conclusions. In surgery, unhappily, we are all too prone to silence in regard to our unfortunate cases, while it is rare that success after any operation at all out of the common course is not made known. This forms the ground of the most weighty of the objections that can be brought against the mode of arriving at results which we have followed, as, by any table of published cases of any particular treatment that may be drawn out, the conclusions furnished will be much too favorable, in consequence of the fortunate cases only (generally speaking) being found recorded. We acknowledge this objection to have weight, but nevertheless look upon even an approach to certain results as of some value, and regard the method employed, when cautiously done, as one of the modes by which sure improvement in our science is to be made.

At the period at which fractured bones become solid under ordinary circumstances, it sometimes happens that the fragments, though united, are not firm. Where this want of firmness exists, the consolidation is said to be delayed; and when this condition is present, and the deposit of bony matter has been hindered by a low state of system, syphilis, scurvy, or other like cause, a continuance of the ordinary treatment together with the use of appropriate remedies for the removal of the general affection which has retarded it, will usually be sufficient to effect a cure. When the deficiency of solidity at this stage is due to the want of appropriate treatment, to the too early use of the limb, or to improper movements of the patient during treatment, success from the persevering employment of the usual means may also be expected, but, when there is an absolute want of callus, or when the states first indicated have been overlooked or not attended to, and complete absorption of that first deposited has taken place, a true ununited fracture may be said to exist. These states, as seen in practice, so run into each other, as to make it often impossible to define with accuracy the exact time at which the fracture may be properly defined to be a disunited one. The lapse of time alone does not indicate it, for sometimes, even after the want of solidity has existed for several months, the deposit of new matter to a greater or less extent about the seat of injury exists, and bony union will ultimately occur without any operative aid.

In the observations which ensue, though simple delayed consolidations will necessarily be often alluded to, yet it is true ununited fractures, those which have failed to unite by bone, under a persevering use of a proper treatment, that are more especially referred to.

As a general rule, fractured bones unite readily; and it may be safely averred that the occurrence of false joint after these accidents is not common. In his paper on the use of vesicatories in this state of parts, Mr. Walker, of Oxford,[1] affirms that he has attended the reduction and after-treatment of not less than one thousand fractures, including simple and compound, and want of union is so rare an occurrence that he does not recollect more than six or eight instances of it. Monfalçon informs us[2] that during a term of six years, passed as interne and surgeon to one of the largest hospitals of Europe, that of Lyons, he met with but one case of non-consolidation after fracture. According to Lonsdale,[3] not more than five or six cases of false joint (except those within a capsule) have occurred out of nearly four thousand fractures treated at the Middlesex Hospital; and Sir Stephen Hammick,[4] whose experience at the Plymouth Hospital was extensive, asserts, that he never discharged from that institution more than three patients with the bones not united. Of the great number of fractures that must have fallen under the notice of Mr. Liston,[5] it happened but in one instance that the bones did not unite. Out of a very carefully prepared table of three hundred and sixty-seven cases of fracture furnished by Dr. Peirson,[1] but a single one is stated to have terminated in artificial joint; and by an Edinburgh writer it is affirmed that cases of non-union are so unfrequent, that it is regarded in that city as a curiosity almost to see them. The writer of the article "Fracture," in the Cyclopædia of Practical Surgery, says, "that in the Richmond Hospital, during a term of six years he has had but one case of false joint" (1842, p. 87), and Mr. Stanley remarks, that "in an experience of sixteen years, in the largest hospital in London, either among his own cases of fracture, or in hundreds of others under Mr. Lawrence, he did not recollect a single case of ordinary fracture treated in hospital which did not turn out favorably. The cases of ununited fractures which he wished to speak about had come into hospital as such, and in too many instances seemed all but incurable."[2] In Philadelphia they are of rare occurrence; at the Pennsylvania Hospital, where between the years 1830 and 1840 nine hundred and forty-six cases of recent fracture were received, no instance of non-union followed the treatment pursued; all the cases observed there during that time (thirteen in number), having been sent to the institution from distant parts.[3] In a further period of ten years, at the same hospital, from 1840 to 1850, twelve hundred and forty-nine cases of recent fracture were admitted, and in no one instance did false joint follow the treatment. The five cases of ununited fractures treated during that time were all admitted as such.[4] The only writer known to me who holds an opinion contrary to that here advanced is Mr. Amesbury; he asserts,[5] that fractures of long standing "are by no means uncommon," and furnishes his personal experience in fifty-six cases of this kind—a number much greater than any one surgeon has ever before had an opportunity of witnessing. We are at a loss to account for its frequency in his practice, but a reviewer of his own nation observes of his statement, that the surgery of fractures must be singularly bad, where one individual has had occasion to number fifty-six examples of non-union, even making allowance for the fact, that all the bad cases came to Mr. A. alone.[1] Setting aside, however, the positive knowledge arrived at by an appeal to figures, we think it evident that the generality of surgeons do not find it of very common occurrence, from the little attention that has been bestowed upon the affection, and the comparatively few cases to be found reported in our journals.

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[1] Lond. Med. and Phys. Journ., xxxii., 1815.

[2] Mems. sur l'état actuel de la Chirurgie, Paris, 1816.

[3] On Fractures, p. 89.

[4] Practical Remarks on Amputations, Fractures, etc., p. 122, 1830.

[5] Lancet, ii. p. 168, 1835–6.

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[1] Remarks on Fractures, Boston, 1840.

[2] Amer. Journ. Med. Sci., 1854, p. 548.

[3] Norris, Am. Journ. of Med. Sci., vol. i., N. S., 1841.

[4] Norris, Am. Journ. of Med. Sci., vol. xxiv., 1852, N. S., p. 301.

[5] Observations on Fractures of Long Standing, p. 195. London, 1829.

To understand well the mechanism of false or artificial joints, and judge of the proper adaptation of the different methods recommended for their cure, a knowledge of the changes that take place in the natural process of reparation of fractured bones is requisite, and we shall preface our remarks on the immediate subject of this paper, by a concise account of the formation of callus.

By the ancients, the union of bones after fracture was attributed to the exudation of a viscous fluid from their surfaces, called the osseous juice, which gradually acquired consistence, and joined firmly together the ends of the broken bone, in the same manner as glue would unite two pieces of wood. This theory of the mode of union continued to be taught till towards the middle of the eighteenth century, when it was overthrown by the experiments of Duhamel. Comparing the periosteum to the bark of trees, Duhamel held that the callus was produced by the elongation and swelling of this membrane, either alone, or together with that lining the medullary canal, uniting themselves to the same parts in the opposite fragments. He then supposed that ossification occurred, from which resulted the formation of two bands or supports, one internal, and the other external, placed between the different membranes and the fragments to which they adhered, and extending from one to the other, in such a way as to maintain them closely in contact. In conjunction with his pupil Dethleef, Haller performed a number of experiments on the formation of callus, the result of which was an opinion contrary to that advanced by Duhamel. He totally discards the idea that the periosteum in any way contributed to the re-establishment of the continuity of the broken bone, and believed the callus to be a jelly-like fluid produced by the fractured surface of the bones, and of the marrow, which gradually became organized and passed through a cartilaginous to a bony state. Bordenave carefully repeated the experiments of Duhamel and Haller, and was led to believe that the formation of callus was due neither to the periosteum nor to the effusion of lymph, and represents the union of broken bones as taking place in a manner similar to cicatrization in the soft parts, that is to say, that the callus is formed by the development of granulations thrown out from the two fragments which become joined together and have then deposited in them the calcareous matter which gives to it the bony character. This opinion has in later times been adopted by Boyer. Macdonald believed all those who had gone before him in error, and regarded the callus from its commencement as a gelatinous mass, to which at a later period, without ever passing into a cartilaginous state, a deposit of calcareous matter gives hardness; and brought forward, as a proof of the correctness of his opinion, the fact of the callus taking a reddish color when an animal is fed upon madder, while this does not take place in the cartilages. John Hunter considered the formation of callus as due to the organization of the blood effused around the seat of fracture, and its consequent conversion into cartilage and bone. The ideas of Hunter relative to the formation of callus have in our own time been in great part adopted by Mr. Howship. The opinion arrived at by this gentleman, after the performance of a number of experiments, is, that the blood effused immediately after the occurrence of a fracture becomes the medium in which the ossific process is first established. According to him, the periosteum assumes by degrees the characters of cartilage, and the bony matter is deposited successively upon the surfaces of the fractured fragments, the circumference of their extremities, and within the medullary cavity. Dupuytren, and the followers of his school, held that the process of union is not exactly effected in any of these ways, and their views, founded principally upon numerous experiments upon the inferior animals, have until a recent period been those generally adopted. According to these authorities, two distinct epochs may be distinguished in the formation of callus, or rather there are two calluses successively formed. The first, termed the "provisional callus," is produced ordinarily in the space of thirty or forty days by the reunion and ossification of the periosteum, the cellular texture, sometimes of the neighboring muscles, and in the long bones, by the ossification of the medullary tissue. The second, called "definitive callus," is formed by the immediate agglutination of the two broken ends themselves, and is never completely finished before eight months or a year, by which time the provisional callus, that is gradually absorbed, has disappeared.

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[1] Edin. Med. and Surg. Journ., xxxi., 1829.

The provisional callus surrounding the fractured fragments, though in larger quantity, is of a less solid nature than that which is definitively formed. The definitive callus when complete, though less voluminous, offers so great a resistance that the bone may be fractured more easily at any other point than that at which it was previously injured.

These experimentalists divide consolidation after fractures into five periods, each characterized by distinct phenomena.[1]

The *first* period extends from the time of fracture to the 8th or 10th day, and presents the following appearances. The blood poured out by the ruptured vessels of the bone, periosteum, medullary membrane, medulla, and the surrounding cellular tissue, coagulates in all the surrounding parts, as well as in the medullary canal. Slight inflammation then follows, the cellular tissue, and the parts adjacent, becoming infiltrated with a gelatinous lymph. In the interior of the bone, the medulla and its membrane likewise become inflamed, and pour out the same substance around and between the broken surfaces, and this effusion produces some thickening about the fracture, which in consequence becomes less movable. The extravasated blood is in a short time altogether, or in part, absorbed: it in no case contributes to the reunion of the fracture, and when in large quantity, rather retards the process. By the end of the period mentioned (10th day), the ends of the fractured bone are surrounded either by a viscid substance, or by a homogeneous tissue of a reddish color and spongy consistence, produced by the general engorgement and infiltration of the soft parts.

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[1] Sanson, Exposé de la Doctrine de Dupuytren sur le Cal., Journ. Univers. des Sci. Méd., tom. xx. Breschet, Récherches sur la Formation du Cal., Paris, 1819, 4to.

The *second* period extends from the 10th day to the 20th or 25th. During this time the swelling of the soft parts diminishes in size, and the different tissues assume their natural appearances. Gradually the muscles, tendons, and other parts are disengaged from the general thickening by which they were surrounded, and there remains only a tumor, separated from all the neighboring parts, even from the tendons, for which grooves, or complete channels, are furnished, in which they move with more or less facility. This tumor is termed the "callous tumor;" it is thicker at the point of fracture than elsewhere, and diminishes gradually in size from this point to its extremities; it is of a whitish color, and has the firmness and consistence of fibro-cartilage, with the fibres running parallel to the axis of the bone. The part of this tumor adherent to the bone is formed by the periosteum with which its substance is blended, and it is more adherent to the bone the nearer we approach the fracture, at which part it becomes difficult to separate it. Towards the extremity of the callous tumor, the periosteum becomes again distinct and easily separable from the bone. The medullary canal is sometimes obliterated at the point of injury, or even for some distance above and below it, in consequence of its membrane becoming thickened; the matter poured out within it passes rapidly to a state of cartilage. During this second period the work of restoration is principally external, the lymph by which the ends of the bone are glued together (within the callus) undergoing but little change. Even at the end of this period, the fracture still admits of motion, though no crepitus or grating can be produced.

The *third* period extends from the 20th or 25th day, to the 30th, 40th, 50th, or 60th, according to the age and state of general health of the patient. During this time ossification proceeds, and the external swelling, or provisional callus, becomes entirely ossified, so as to form a firm bony clasp. The periosteum is thicker than in the natural state, becomes apparent upon the tumor, and is continued both above and below with that of the fragments. The muscles and tendons have by this time become free from the tumor, though they do not admit of much motion on account of the rigidity of the cellular tissue. At the end of this period, in the case of a thigh, or leg, the fractured limb has sufficient strength to permit of its being used, though if the callus at this time be divided, it will be found that the extremities of the bones move readily upon each other, the substance existing between the fragments being as yet soft and vascular.

The *fourth* period extends from the 50th or 60th day to the end of the 5th or 6th month. During this period the ossified callus becomes closer and more compact. The soft substance joining together the ends of the bone gradually ossifies, and the fractured extremities, which hitherto have not been united, are now found to be connected by a layer of newly formed and compact bone. This is termed the definitive callus, and in proportion to its formation is the provisional callus diminished.

The *fifth* period extends from the 5th or 6th, to the 8th, 10th, or 12th month. In this period, the external provisional callus, having served the purpose of keeping the ends of the bone in contact for a certain time, is entirely absorbed, while that portion of it formed by the medullary effusions is also absorbed, and the medullary membrane returns to its natural state. The periosteum assumes its normal thickness and texture, the cellular tissue its elasticity, and the muscles and tendons regain their free motion. Finally, the definitive callus is wrought into cells and canals, by which the continuity of the medullary cavity of the bone is restored, and the work of consolidation is terminated.

Such are the phenomena, according to the school of Dupuytren, which accompany the formation of callus in ordinary cases, where the fractured fragments have been placed in a good position; but sometimes it happens that the ends of the broken bone, instead of being placed in apposition, touch only at a single point, and nevertheless the bone becomes united. In these cases, it is asserted, the definitive callus never takes place, but the fragments are held together by the provisional deposit, which becomes permanent, and forms a firm bond of union. When fracture is complicated with a wound and suppuration follows, after a lapse of time, ordinarily of several months' duration, during which splinters of bone, if there be any, are thrown off, the extremities of the fragments become softened and covered with vascular granulations, and unite together in a mode analogous to that of suppurating wounds of the soft parts, and it is this cicatrix which, by a deposit of bony matter in it, constitutes the callus.

From what has been stated in regard to the formation of callus, it appears by this theory—

1. That, when a fractured cylindrical bone unites, a broad band or support, acting like a circular splint, and termed provisional callus, is first deposited around the seat of injury, by which the extremities are brought together and fixed.

2. That the permanent callus is formed between the ends of the bone only, and unites firmly and closely the fractured surfaces.

3. That, when the permanent callus is produced, that first deposited, having fulfilled its transient purposes, is entirely absorbed.

4. That, at the period at which splints are usually laid aside, and the union is looked upon as firm, the deposit of the permanent callus is scarcely begun, the firmness in the broken part depending solely upon the temporary deposit.

In these cases, the provisional callus forms the firm bond of union. By this theory phenomena may be explained which are sometimes observed after fractures; the renewal of the deformity after the removal of splints, at the end of a period that experience shows generally to be sufficient for a cure, the possibility of remedying, by a proper and well directed treatment, limbs that are deformed, and why this possibility exists only during a certain time, and then ceases, are readily explained by it. They are fruitful too in practical hints relative to precautions that should be taken during the convalescence of fractures, particularly when oblique, as well as in regard to the length of time that, in certain cases, it is necessary to prolong the application of an apparatus, and point out the probability of rupturing advantageously within a certain period the callus of badly set bones. The more recent continental observers, in their descriptions of the process of repair after fractures, although they have added much to our knowledge of the minuter histological changes in the fractured parts, agree in all essential points with the teachings of Dupuytren. Among these are Virchow,[1] Foerster,[2] Rindfleisch,[3] Billroth,[4] and Gurlt.[5]

Late and high authorities on this subject, however, affirm that the descriptions of Dupuytren and others, drawn principally, as they are, from the examination of fractures in the lower animals, cannot be applied without great deductions to the cases of fracture in man, and that true as the pictures are of the cases of the animals experimented on, they are exaggerations of the process in the human subject, and that the doctrine of the formation of provisional callus is generally true only in the case of animals, in whom it depends on the constant movement and disturbance to which their bones when broken are subjected.

From careful examinations of many specimens in the adult, Paget is convinced that the normal mode of repair in them is accomplished by intermediate callus. The principal features of difference between it and that just described are, (1) "that the reparative material is placed between the fragments, not around them; (2) that, when ossified, it is not a provisional, but a permanent, bond of union for them; (3) that the part of it which is external to the wall of the bone is not exclusively, or even as if with preference, placed between the bone and the periosteum, but, rather, in the tissue of the periosteum, or indifferently either in it, beneath it, or external to it." When the fragments are placed in close apposition, he believes they may be joined by immediate union; "but, if this do not happen, a thin layer of reparative material is deposited between them; it does not, in any direction, exceed the extent of the fracture; neither does it, in more than a trivial degree, occupy the medullary canal; but, being inlaid between the fragments, and there ossifying, it restores their continuity."[1]

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[1] Cellular Pathology, Trans. by Chance, pp. 438–441. 1860.

[2] Handbuch der Path. Anat., p. 865, 2d edit.

[3] Handbuch der Pathologischen Gewebelehre, p. 524, 2d edit. 1872.

[4] Chirurgische Pathologie und Therapie, p. 195. 1868.

[5] Handbuch der Lehre von den Knochenbrüchen. 1862.

Dr. F. H. Hamilton,[2] in 1853, published conclusions nearly or quite identical, though independently arrived at, with those promulgated by Paget, and concludes that "fractures in adult human bones, whether placed end to end or overlapped, unite most naturally and most promptly, either immediately or mediately, and in the same manner that soft tissues unite; that is to say, without the interposition of any reparative material, or through the medium of an intermediate, permanent callus, and that all deviations from these simple methods are accidental, or the result of disturbing influences."[3]

Perfect osseous union, however, is sometimes not effected between the extremities of a fractured bone, and we propose now to investigate the appearances presented by the parts where this failure exists. Authorities differ as to the state in which the bones are found upon dissection in ununited fractures, though generally, the opinion maintained by Boyer, that a true joint, with a well-marked capsular ligament containing a fluid resembling synovia, is never formed, has been adopted. That in the majority of instances this opinion may be correct, we are willing to acknowledge, though an examination of such post-mortem examples as we have found recorded, as well as instances that we have ourselves observed, show that it is not uniformly the case. The mode of union between the fractured extremities in these cases may be described as of four kinds.

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[1] Lects. on Surgical Pathology. Lond. 1863.

[2] New views of Provisional Callus. Buffalo.

[3] On Fractures.

In the *first*, the bones are united together by the fibro-cartilaginous mass, which has been described under the name of the callous tumor, the formation of which has gone on regularly, but in consequence of some retardation in the process, bony matter is not deposited, and as a consequence, it wants solidity, the part continuing easily movable. It is in this state that the bones are found in what are termed delayed consolidations, and it is to this class of cases, as we shall hereafter see, that the treatment by rest and compression is peculiarly suited. The rough handling of a limb in this state is always accompanied with some pain, a circumstance of much importance in its diagnosis.

In the *second* class of cases, there is entire want of union of any sort between the fragments, the ends of which seem to be diminished in size, and are extremely movable beneath the integuments. The limb in these cases is found greatly shrunken, and hangs perfectly useless.

In the *third* and most common class of cases, the medullary canal is obliterated in both fragments, and the ends of the bone are found more or less absorbed and rounded, or are pointed and covered by a tissue resembling the periosteum, and are connected together by strong ligamentous or fibro-ligamentous bands, passing from the extremity of one fractured fragment to that of the other. Sometimes this bond of union is constituted by a single ligament, while in other instances it is made up of several narrow bands having separate attachments: in either case the newly formed substance is firmly adherent to the bones, and if of any length is in a high degree pliable. Instances of this sort of union are often seen after transverse fractures of the patella and olecranon.

In the *fourth* class of cases, a dense capsule without opening of any sort, containing a fluid similar to synovia, and resembling closely the complete capsular ligaments, is found. In these cases, the points of the bony fragments corresponding to each other are rounded, smooth, and polished, in some instances are eburnated, and in others are covered with points, or even thin plates of cartilage, and a membrane closely resembling the synovial of the natural articulations. It is in this kind of cases that the member affected may still be of some utility to the patient, the fragments being so firmly held together as to be displaced only upon the application of considerable force. Boyer,[1] Hewson,[2] Chelius,[3] and other writers have doubted the existence of these newly formed joints; but the observations of Sylvestre,[4] of Brodie,[5] of Béclard,[6] Home,[7] Howship,[8] Otto,[9] Kuhnholtz,[10] Houston,[11] Key,[12] Cruveilhier,[13] and Langenbeck, all show that such are occasionally found. In a number of experiments on resection of the hip-joint in animals, made by Chaussier,[14] Koehler, and Wachter,[15] the muscles were found to have drawn the parts together, the extremities of the femur and the corresponding portions of the ischium being incrusted with a cartilaginous substance and membranous capsule, containing serous fluid formed around the new articulation. In nine false articulations which he produced in a series of experiments upon dogs, M. Breschet[16] observed six in which the extremities of the bone were rounded, and cartilages, synovial membranes, and all the other appearances constituting a true joint formed, while in three only were the bones connected by means of a ligamentous matter passing from one extremity to the other.

When the fractured fragments have been for a long time disunited, the structures of the bones themselves undergo a change, and become very light, being deprived of their reticulated spongy substance, and reduced to a mere shell of compact structure.

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[1] Maladies Chirurgicales, iii. p. 103. Paris, 1831.

[2] North American Med. and Surg. Journ., No. 9, p. 7, 1828.

[3] Traité de Chirurgie, Trad. par Pigné, p. 150. Bruxelles, 1836.

[4] Nouvelles de la République des Lettres of Bayle, p. 718, July, 1685.

[5] Lond. Med. Gaz., xiii. p. 57, 1833.

[6] General Anatomy, Trans. by Hayward, pp. 149, 248.

[7] Trans. of Med. Chir. Soc. of Edinburgh, i. p. 233, 1793.

[8] Med. Chir. Trans., viii. p. 517, 1817.

[9] Patholog. Anat., Trans. by South, i. p. 138.

[10] Journ. Complementaire, iii. p. 291.

[11] Dublin Med. Journ., viii. p. 493.

[12] Cooper on Fractures and Dislocations, 4th ed. p. 508. London, 1824.

[13] Anat. Patholog., tom. i. 374.

[14] Méms. Med. Soc. d'Emulation, tom. iii.

[15] De Articulis Extirpandis. Gröningen, 1810.

[16] Loc. cit. p. 34.

The *causes* of non-union after fracture are either constitutional or local. Among the constitutional causes, the existence of *syphilis* in the system is generally looked upon as being sufficient to retard, or altogether prevent, the process of union after fractures. Numerous instances in which this has been the apparent cause might be cited from the old writers. Among the moderns, M. Sanson is one of those who lay most stress upon it. "I have twice," says he, "had occasion to observe the marked influence of syphilis in retarding consolidation. One of the cases was a fracture of the leg, which was not firm after eight months' employment of the ordinary means of treatment. The other was a fracture of the humerus, which was not united after eighteen months, except by a soft and flexible substance. In both these cases, unequivocal proofs existed of concomitant syphilitic affections, and, after an anti-syphilitic treatment of two months was employed, consolidation took place."[1] Bérard[2] mentions the case of a simple fracture of the leg, observed by M. Nicod, in which there was no union after nine months of treatment, when, syphilitic symptoms being discovered, the patient was placed under a mercurial course, and consolidation took place. An instance was related to the Academy of Medicine of Paris, by M. Beulac,[3] of a fracture that had existed two months, where the consolidation was retarded by syphilis, under which the patient labored, and at the same sitting several members stated like facts. The following case, in which want of union seemed owing to the existence of syphilis, has been obligingly communicated to me by Dr. Condie: On the 28th of August, 1828, J. Rowen, æt. 48, fractured both bones of the left forearm, some inches above the wrist, by a fall from a hay loft. A few hours subsequent to the accident the bones were properly reduced, and the arm put in splints. He was a man of dissipated habits, and had been, since his twenty-first year, repeatedly under treatment in hospitals for syphilis. At the time of his accident, he was laboring under ulceration of the throat, nodes and cutaneous blotches, and his gums and breath exhibited indications of mercurial action. The Lisbon diet drink and a nourishing diet were ordered, in addition to exercise in the open air. On the 30th of September, no attempt at union having taken place, Dr. Physick saw the patient, but suggested no change in the treatment. On the 22d of November, eighty-five days after the occurrence of the accident, when the patient was last seen, no union was perceptible. Breschet[1] mentions the case of an adult, in whom several fractures existed, all produced by muscular action alone, and who voided daily with his urine a large quantity of sandy matter. Syphilis being suspected as the cause of this state, the rob of Laffecteur was administered, sometime after which consolidation of the broken bones occurred. Opposed to these statements, however, the great experience of M. Lagneau[2] may be quoted, who mentions that he has witnessed numerous examples of fracture, in which union took place promptly, notwithstanding the existence of constitutional syphilis. Oppenheim,[3] too, avers, that he has observed various cases, in which, general syphilis being present, fractures united exceedingly well, and is inclined totally to discard the suspicion that syphilis, in any way, retards the union of broken bones. I have, myself, treated fractures in patients laboring under constitutional syphilis, and have never noticed any delay in the union. M. Bérard, after numerous researches, sums up his opinion in the following language:[4] "Despite the numerous occasions in which surgeons have witnessed the coexistence of syphilis with fractures, it has been very rarely proved that the syphilitic virus exercises any influence upon the formation of callus."

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[1] Dict. de Méd. and Chir. Prat. iii. p. 492.

[2] Des causes qui empechent ou retardent la consolidation des Fractures et des moyens de l'obtenir.—Thèse, Paris, 1833.

[3] Journ. de Méd. Chir. and Pharm. in 40 vols., tom. xxv. p. 216.

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[1] Dict. de Méd. Art. Pseudarthrose, 2d edit. p. 231.

[2] Exposè des Symp. de la Mal. Vénérienne, p. 525. Paris, 1818.

[3] On False Joints, in Zeitschrift fur die Gesammte Medicin, No. 5, May 1837.

[4] Op. citat. p. 11.

Pregnancy and *lactation* are stated in most of our treatises, also at times to retard, or prevent, firm union from taking place after fracture.

As a general rule, it may be said that these states do not interfere with the occurrence of bony union. Of fifty-six cases examined by Mr. Amesbury,[1] but two happened during the process of gestation, and these he is not disposed to attribute to the peculiar disturbance of the system which is observed in pregnancy. Callisen[2] reports that he has, in several cases, seen fractures in pregnant women get perfectly well, though the time required for firm union was a little longer than that ordinarily demanded. Of four cases of fracture which came under the care of Mr. Latta, in the fifth, sixth, and seventh months of pregnancy (two of the thigh, one of the tibia, and one of the forearm), all were cured in the ordinary time.[3] Mr. Liston[4] has often seen fractures in women carrying children unite as speedily and firmly as if the patients had not been in that state, and otherwise in robust health; but observes, "profuse uterine or vaginal discharges, or determination to particular parts or organs, will certainly retard union." Leveillé mentions the case of a pregnant woman cured of a simple fracture in the usual time.[5] Breschet[6] has observed numerous cases at the Hôtel Dieu of Paris, in which fractures have occurred in pregnant women, and has never observed the slightest influence exerted upon the reparative process by this state of system. Several of my friends, who have had opportunities of observing fractures in this class of patients, have assured me that the injuries have been repaired in the usual period. That, however, these states do occasionally retard the reparation of fractured bones, there can be no doubt. Heister[1] observes, "when fractures happen to big-bellied women they are seldom cured till they have got rid of their burthen." Werner[2] has published the case of a fractured radius in a pregnant woman, where the cure was apparently retarded for a long time by this circumstance, and though the union took place previously to delivery, the callus was not very firm till after that event. Fabricius Hildanus,[3] Wilson,[4] Ferdinand Hertodius,[5] have all witnessed cases in which this retardation had taken place. A remarkable and well-detailed instance of this kind is recorded by Mr. Alanson.[6] It is that of a delicate female, who, in the second month of pregnancy, met with an oblique fracture of the tibia, which, in spite of a well-directed treatment, had not united when she was delivered at full time (seven months after the accident), but which, as she recovered strength after her confinement, began to unite, and nine weeks after this period was able to walk about her room with a firm limb. What proves beyond a doubt in this case that the want of union was owing entirely to her pregnant state was, that three months before impregnation she had been very happily and speedily cured of a fractured femur.

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[1] On Fractures, 2d ed. p. 197, 1829.

[2] Syst. Chir. Hodiern. Pars 1, § 1313.

[3] System of Surgery, iii. p. 363.

[4] Elements of Surgery, 2d ed. 1839, p. 686.

[5] Nouvelle Doctrine Chirurgicale, tom. ii. p. 159.

[6] Dict. de Méd., tom. xxvi., 2d. ed., p. 231.

Another well-described case, in which a fracture received during pregnancy did not unite till after delivery, was observed by Dr. Bard of New York, and is to be found in the *Philosophical Transactions*, xlvi. p. 397, 1750. In this instance the left forearm was fractured obliquely in the third month of pregnancy; finding the arm continued flexible at the end of seventy-five days, though the ends of the bones were in perfect apposition, Dr. B. applied an apparatus to keep the limb in a good position, and gave encouraging hopes to the patient that after her labor, the economy of nature would be more immediately directed to the recovery of the use of her arm. In less than a month after her delivery, the callus was fully formed, and the patient recovered the use of her arm. M. Lepiez[1] has given an interesting case of the same kind. The patient, two and a half months advanced in pregnancy, fractured her humerus, besides receiving some severe wounds of the soft parts. At the end of six weeks the wounds were healed, but the fracture had not united. The treatment was continued in the hope of this occurring after her confinement, and took place firmly and well at the expiration of a month after that event. Another observation of fracture of the middle of the femur, occurring in a young and healthy woman, advanced to the third month of pregnancy, treated at the Hospital St. Antoine in Paris, in whom union failed to take place until one month after delivery, when the consolidation became perfect, has been detailed by Dupuy.[2] The following case, kindly furnished to me by Dr. Condie of this city, also strikingly shows the influence that may be exerted by a state of pregnancy upon the consolidation of fractures. S. R., æt. 36, on the 13th of October, 1820, being then in the eighth month of her third pregnancy, fell in going up stairs and fractured her right humerus immediately below the insertion of the deltoid muscle. The fractured bone was carefully adjusted within half an hour after the accident, and, the patient being to all appearance in perfect health, a speedy union was anticipated. No union occurring, Dr. Physick saw the patient on the 13th of November, and carefully examined her arm. He remarked, that, according to his experience, fractures occurring in pregnant females often remained ununited until after parturition, when union very generally and rapidly took place, and believed this would be the case with S. R. provided motion at the seat of injury was guarded against.

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[1] System of Surg., Lond. 1763, p. 120.

[2] Richter, quoted from Cooper's Dict., p. 546, ed. 1838.

[3] Opera. 1681, Cent. 5, Obs. 87, and Cent. 6, Obs. 68.

[4] On the Human Skeleton, p. 214.

[5] Ephem. des Cur. de la Nat. 1re anneé obs. 25, quoted from Bib. Choisie de Méd. xxiv. p. 595.

[6] Med. Obs. and Inquiries, iv. 1772.

On the 27th of November, the patient was delivered of a healthy child, rather above the common size, and by the 31st of December the bone had become firmly united.

Whether the states of pregnancy or of suckling have any direct effect in preventing union of the bones, or whether this is only in consequence of the debility which these conditions of system often induce, is undetermined. I am myself inclined to adopt the latter supposition, and in support of it will adduce the cases reported by Sir Stephen Love Hammick. "I have seen," observes this author,[1] "three cases of this sort, one of the leg, in a woman in the first months, who was extremely debilitated from an incessant irritability of stomach, causing her to reject all her food, but as the pregnancy advanced her stomach became tranquil, when on recovering her strength the bone united. Another had a fracture of the humerus in the latter months; the patient was in a state of great exhaustion; after her delivery she would persist in nursing the child, which continued her weakness, and it was not till two months after she consented to wean it that the bone united by the vigor of the system having returned. The third was in the last months of pregnancy, and after delivery, not attempting to nurse the infant, she rapidly improved in health, and the limb quickly got well."

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[1] Journ. de Chirurg., 1845.

[2] Gaz. Médicale, 1855, p. 408.

Cancer has been placed among the causes which hinder the consolidation of fractured bones, though perhaps by the generality of authors it is denied to exert any influence over the process. "Women laboring under cancer," says Sir B. Brodie,[2] "are liable to a similar disease of different bones of the body, which then become brittle and very liable to break. I saw an old woman dying of this disease who in turning in bed broke the femur; union took place here as well as under ordinary circumstances. I attended a lady who had cancer of the breast, and a scirrhous affection of the collar bone, and one day in moving her arm, the collar bone was broken, but it united just as if it had been a healthy bone." Mr. Liston[3] has recorded the case of a female, æt. 49, affected with carcinomatous tumors under the jaw and in both breasts, as well as in the uterus and other internal organs, in whom firm union occurred after two fractures of the left and one of the right humerus, all received within fourteen months, and produced by very slight causes. Mr. Coates and Sir Charles Bell[1] have given, each a case, of fracture occurring in cancerous patients, where no sort of union had formed after eight and six weeks, and where cancerous matter was found deposited in the bones. M. Coling[2] describes the case of a woman, aged sixty-eight, affected with an encephaloid tumor of the neck, who fractured the femur in the act of stooping to urinate, in whom no union took place, and on dissection, fourteen months after the accident, the same encephaloid matter was found to be developed to a great extent around the fractured bones. I have seen two instances of fracture of the femur in middle-aged persons, produced by slight causes, in which like deposits were found. After a very careful examination of what has been written upon the subject, I believe it may be stated that, where the fracture arises in consequence of a true cancerous deposit around, or in the interior of the bones, and producing absorption of their tissue, no union takes place, but where, as is usually the case, it is owing to a mere brittleness of the bones occasioned by what has been denominated by Mr. Curling eccentric atrophy, fractures, though occurring from very slight causes, will unite readily.

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[1] Practical Remarks on Amputation, Fractures, etc., p. 121.

[2] Lond. Med. Gaz., xiii. p. 56, 1833.

[3] Practical Surgery, 2d American edition, p. 100.

Fragility of the Bones.—The same cause which gives rise to undue fragility in the bony structure might, *a priori*, be supposed to retard, if it did not altogether prevent, their consolidation after fractures. Experience however proves this not to be the case, and generally, indeed, it may be said, that, where a proneness to fracture from trifling causes exists, these accidents are repaired with great facility. Dr. Good[3] mentions the instance of a lady æt. 72, who broke both femurs by merely kneeling down at church, and who had the humerus also broken in the efforts made to remove her, without any violence, and with little pain. Scarcely any constitutional disturbance followed, and the bones united in a few weeks. Mr. Tyrrel[4] had under care a patient who had suffered twenty-two fractures, and the accidents were repaired with greater facility than in other individuals, the femur being perfectly firm at the end of three or four weeks. An interesting history has been furnished by Dr. Pauli of Landau[1] of an hereditary brittleness of the bones occurring in a healthy family, and one apparently free from any scrofulous or other taint. Three of them had each had two fractures, another three, either of the arm or leg; one of them had as many as five fractures of one or the other extremity, all produced without any considerable violence. In every instance the fracture was speedily cured, generally the callus being perfectly firm at the end of three weeks, and, when the same bone was broken a second time, it never occurred at the seat of callus. Professor Gibson[2] speaks of the case of a young man who in a period of twenty-three years experienced twenty-four fractures. From infancy he had been subject to fractures from the slightest causes, and his limbs had all been repeatedly broken, even from so trivial an accident as catching the foot in a fold of carpet whilst walking across the room. The clavicles had been fractured eight times. The boy always enjoyed excellent health, and the bones united without difficulty or much deformity. The same author furnishes four other cases, observed by different gentlemen in our country, in all of which fragility existed in remarkable degrees. In the cabinet of M. Esquirol[3] the skeleton of a rachitic woman is to be seen, in which exist traces of upwards of two hundred fractures, all more or less firmly consolidated.

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[1] Lond. Med. Gaz., xiii.

[2] Archiv. Gén., vol. xxxvii. p. 527, 1835.

[3] Study of Medicine, v. p. 332, 3d ed.

[4] St. Thomas's Hosp. Reports, vol. i.

Scurvy, fevers of a low type, or any other disease inducing great debility or actual prostration, may also prevent the reparative process after fractures from taking place as in ordinary cases.

The cause of want of union is sometimes to be found in the *general impoverished and bad state of the system*, produced by improper abstinence from food, or the withdrawal of an habitual stimulus. The following cases illustrative of this cause are given by Sir B. Brodie.[1] "A gentleman was growing fat, and, not liking to do so, he placed himself on a very slim diet, though accustomed to good living previously. After six months of starvation he broke his arm, and the bone would not unite. I saw him many months afterwards, and there was scarcely any union, even by soft substance. Another patient about whom I was consulted, a lady, was growing fat, and thought she would also prevent it by pursuing a similar system of diet. Some months afterwards she broke her arm, and union did not take place." A striking instance of the same cause in preventing union is related by M. Noel,[2] of a girl, ætat. 18, of good constitution, in whom no attempt at union had taken place after a fracture of the leg at its middle part, at the end of eight months. The patient was greatly reduced from want of nourishment, she having subsisted for some time upon six ounces of bread, with water, per diem. Supposing want of union to depend upon insufficient nourishment, she was placed upon a good diet, and about six weeks afterwards union of the fractured bones was perfect. Beckett relates the case of a patient, ætat. 23, with fractured os humeri, in whom the loss of a large quantity of blood, and the denying him a competent sustenance, prevented reunion till the end of nine months.[3] Mr. Wilson[4] mentions an instance in a woman with a fractured leg, who had led an intemperate life, but who after her accident had been refused strong liquors, where union did not occur, but, upon a moderate quantity of spirits being allowed her, it got well almost immediately. On the breaking of her other leg, which happened within a year after her first accident, spirits were not entirely refused her, and the bones united in the usual time. A very curious case has been recorded by Mr. Fowler, of Cheltenham,[5] showing that, while a patient was suffering from hæmoptysis, nature furnished the cartilaginous cement very abundantly; and that, when this symptom ceased, the earthy matter was liberally supplied, and a large portion of the cartilaginous medium removed. The subject was a male, aged fifty, of a consumptive tendency, who fractured his femur. For the first three weeks he appeared to do well, and then began to complain of pain in the chest, and had bloody expectoration. About the seventh week callus was found to have been profusely deposited around the seat of fracture, being "a mass nearly equal in size to the head of a new-born infant," but so entirely deficient in earthy material, that the weight of the leg was sufficient to bow the thigh at the fractured part. The bone was again adjusted as before, the expectoration suddenly ceased, the appetite, appearance, and strength rapidly improved, and at the end of the twelfth week the callus had diminished to nearly half its size, and the patient could bear his weight upon it. A case in which want of union may perhaps be attributed to slim diet together with repeated bleedings, is given by Dr. Hewson.[1] This patient was admitted into the Pennsylvania Hospital in March, 1827, on account of an imperfect union of the tibia near its centre. In August, 1818, both bones of the leg were broken. He was subjected to a severe antiphlogistic treatment, and lost several pounds of blood. It was not until six weeks after the accident that he was allowed any portion of animal food. Other striking illustrations of the effect of an altered mode of living may be found in the *Medico-Chirurgical Review* for January, 1836.

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[1] Journ. de Chirurg., Jan. 1845.

[2] Institutes and Practice of Surgery, i. p. 233, 1838.

[3] Dictionnaire de Médecine, xiii. p. 407, 2d ed.

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[1] Lond. Med. Gaz., xiii. p. 56, 1833.

[2] Prix de l'Acad. de Chirurg., v. p. 45, 8vo., Paris, 1819.

[3] Chirurgical Observations, p. 16.

[4] On the Human Skeleton, 1820, p. 227.

[5] Med.-Chirurg. Rev., vol. vii. p. 574, N. S., 1827.

The influence of a low diet, long continued, upon the parts interested in compound fractures, must have been noticed by all surgeons, and the good effect produced in such cases by an increased diet, and the allowance of an accustomed stimulus, as well in causing the more rapid deposit of callus, as in improving the state of the wound, have been observed. That the large abstraction of blood alone will not prevent the formation of callus is well seen in the following cases.

Isaac Yorke, ætat. 19, was admitted into the Pennsylvania Hospital October 5th, 1801, for fracture of the right thigh. His accident had happened one week previously to his admission, during which time he had been delirious, and had undergone five bleedings, in all amounting to one hundred and two ounces. He continued to do well until the 7th, when his delirium returned, and between this date and the 15th he was bled at different times to the amount of ninety ounces, making in all one hundred and ninety-two ounces; from the 15th he recovered rapidly, and was discharged from the hospital January 13th, 1802.

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[1] North American Journ. for Jan. 1828, p. 11.

Jas. Orr, ætat. 32, was admitted May 16th, 1804, for compound fracture of the leg two inches above the ankle, and injury of his thorax. Great pain and difficulty of breathing followed the accident, to relieve which he lost thirty ounces of blood in the first twenty-four hours following it. On the 20th delirium set in, and in the two following days sixty-two ounces more of blood were taken from him, making in all ninety ounces; after this his symptoms abated, and he recovered rapidly.[1]

The influence of the nervous system over the processes of reparation in the body is well known, and that *want of nervous influence* might alone be sufficient to prevent consolidation after fracture from occurring, has been supposed. That it may be a sufficient cause there can be no doubt; an instance is mentioned by Mr. Travers,[2] in which union failed to proceed after a fracture of the leg that was paralyzed from fracture of the lumbar vertebræ, although the humerus, broken at the same time, united perfectly in the usual period. Mr. Benjamin Phillips[3] has seen a case in which the same injury that fractured a man's leg injured the lower part of the spine; he lived five weeks, but there had been no effort at reparation. Diminished nervous influence will not, however, in all instances, hinder the formation of callus, as is shown by a case recorded by Mr. Busk,[4] of a gentleman, ætat. 65, who had been more or less paralytic for upwards of twenty years, for the last twelve or fourteen of which he had been completely deprived of all power of motion and sensation from the loins downwards, who fractured his left leg below the middle; and in whom at the end of five weeks the bones had firmly united.

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[1] Penn. Hosp. Case Book, i. pp. 27, 31.

[2] Further Inquiry, etc., p. 436.

[3] Lond. Med. Gaz. for May, 1840, p. 327.

[4] Lond. Med. Gaz. for April, 1840, p. 97.

Another instance of the same kind has been reported by M. Reynaud[1] in which the formation of callus and firm consolidation took place in the usual time, and Mr. Toogood[2] attended a man who had for many years been in a weak, nervous, and half-paralytic state, who broke his femur by turning in bed, which was treated in the common way and united after a considerable time. Roechling has proved by experiments upon young dogs, that the formation of callus, though not entirely prevented by division of the nerves of an extremity, was nevertheless greatly retarded, and indeed did not take place perfectly.[3] The last experimenter whose statement I have seen on this matter[4] asserts, that where the sciatic nerve was resected in lambs consolidation of a fracture took place as perfectly and rapidly as where the nerve was untouched.

Three interesting cases of fracture have been reported to the Société de Chirurgie by Baron Larrey, to prove the facility of the production of fractures in paralyzed limbs. In one of the cases there was incomplete paraplegia of the lower limbs, with increased sensibility. During a moment of suffering, the patient had to put one of his legs upon the other, while he pressed upon the thigh with his hands, and the femur broke at about its middle. The fracture was very long in being cured, and the patient died from the progress of his paralysis. In a second case, there was also paraplegia besides amaurosis. In making an effort to put on a boot, the patient, aged thirty, broke the femur in its lower part. The fracture was compound and the upper fragment protruded. The spasmodic movements prevented the contact of the fragments, but nevertheless, irregular consolidation took place. The patient died. In the third case, there was incomplete paraplegia in an officer, aged forty. The fracture was oblique, and caused by an effort to take off his boot, and was at the inferior part of the bone. More than ten months have elapsed, and consolidation has not yet taken place.[1]

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[1] Journ. de Chirurg., p. 349, 1843–4.

[2] Provin. Med. Journ., vol. ix. 1842.

[3] Quoted from Miescher, "De Inflammatione Ossium. Berolini," 1836.

[4] Ollier, vol. i. p. 230.

Cutting off the direct supply of blood to an extremity by ligature of the principal arterial trunk might, *a priori*, be supposed sufficient to retard union after fracture. This however does not seem always to exert a marked influence upon the process. Petit[2] mentions a fractured leg accompanied by rupture of the anterior tibial artery, in which union was effected in the usual way. In the Surgical Essays of Mr. B. Cooper, is a case of fractured femur accompanied with injury to the popliteal artery, where, although the femoral was taken up, the fracture was soundly united in six weeks. In a case, however, of a similar kind, reported by Dupuytren,[3] the work of consolidation went on slowly, the nutrition being weakened in the limb by the ligature of the artery. At the end of the first month, the callus had scarcely begun to be formed; at the termination of the second, union was very weak, and it did not become perfectly solid till after the expiration of four months. In animals, such as guinea pigs, rabbits, etc., Brodie has found by experiment, that the reparative process in a fracture of the thigh bone is delayed in its commencement for a week or a fortnight, by placing a ligature on the femoral artery, but at the end of that time union goes on as though no such operation had been done.[4]

Bérard[5] has shown that the period at which the epiphyses are joined to the diaphyses of the long bones, depends upon the direction of the nutritive artery—for example, it is found that in the humerus, where the direction of this vessel is from above downwards, consolidation takes place soonest at its inferior extremity. In the forearm, the course of the nutrient vessel is from below upwards, and here consolidation of the epiphyses is found to occur at the elbow sooner than at the wrist. In the inferior members, on the contrary, the epiphyses

[1] Med. Times and Gaz., vol. xvi. N. S., 1858, p. 44.

[2] Mal. des Os, quoted from the thesis of Bérard, p. 27.

[3] Leçons Orales, iv. 618.

[4] Lancet, i. p. 381, 1840-1.

[5] Archives Générales, xxxvii. p. 176, 1835.

composing the knee are the last which become firm, because in the femur the nutritious artery runs upwards, and in the bones of the leg it courses from above downwards. Aware of these facts, M. Guèretin[1] was led to examine into the influence which the direction of the nutritious arteries exerted upon the consolidation of fractures, and has asserted that ununited fractures are most common in the points opposite to the direction of the nutritive vessel. The following analysis of 35 cases, to show the relation between the seat of ununited fractures and the nutritious vessels, copied from his paper, possesses much interest:—

Bones affected.	No. of Cases.	Seat of Fracture.
Humerus	9	Above the entrance of the nutrient artery (upper half of bone).
Do.	4	Below the entrance of the nutrient artery (lower half of bone).
Forearm	1	Above the entrance of the nutrient vessels of the two bones (superior third).
Do.	7	Below the entrance of the nutrient vessels of the two bones (lower half).
Femur	3	Above the entrance of the nutrient vessel (superior half).
Do.	5	Below the entrance of the nutrient vessel (lower half).
Leg.	4	Above the entrance of the nutrient vessels of the two bones (superior third).
Do.	2	Below the entrance of the nutrient vessels of the two bones (lower half).

As the seat of the entrance of the vessel varies, though but little, and very rarely, cases of non-consolidation have been taken for this table which are distant at least one inch from the point usually assigned for its entrance.

In addition to the researches of M. Guèretin, it has been shown by Mr. Curling,[2] that, in fractures of the long bones, the portion below the entrance of the nutrient artery becomes gradually atrophied, being supplied only by the periosteal branches. Thus, in femurs fractured below the entrance of this vessel, the inferior cavity of the lower extremity becomes enlarged, the cancelli expanded, and the walls thinned. A like alteration is observed in fractured tibia, whilst in a humerus, broken near the middle and somewhat above the entrance of the nutrient artery, the upper portion was the seat of change. My own researches on this point do not, however, confirm those of M. Guèretin. An analysis of 41 cases in which I find the exact point of fracture indicated, gives the following result:—

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[1] Presse Médicale, i. p. 45.

[2] Med.- Chir. Trans., xx.

Bones affected.	No. of Cases.	Seat of Fracture.
Humerus	4	Above the entrance of the nutrient artery (upper half of bone).
Do.	9	Below the entrance of the nutrient artery (lower half of bone).
Forearm	1	Above the entrance of the nutrient vessels of the two bones (superior third).
Do.	3	Below the entrance of the nutrient vessels of the two bones (lower half).
Femur	7	Above the entrance of the nutrient vessel (upper half).
Do.	6	Below the entrance of the nutrient vessel (lower half).
Leg.	1	Above the entrance of the nutrient vessels of the two bones (superior third).
Do.	10	Below the entrance of the nutrient vessels of the two bones (lower half).

Advanced age is placed among the causes which always retard the consolidation of fractured bones, though the reading of observations reported, and daily experience, do not confirm it. In some cases of this kind, I have seen the callus deposited and firm union occur remarkably soon. In 1838, two instances in which this took place were treated by me at the Pennsylvania Hospital. In one of them, occurring in a man aged ninety, the humerus was fractured near its middle, and under the usual treatment, firm union took place at the end of six weeks. In the other, a decrepid female, aged eighty, who died from exhaustion eighty-four days after fractures of the middle of the femur, and the ilium, the mass of matter thrown out around the fractured portions was truly astonishing. An instance is mentioned by Professor Horner,[1] in which a simple fracture of the os humeri occurring in a female, aged ninety, was firmly united at the end of five weeks. Firm union of an oblique fracture of the femur near its middle, on the forty-fourth day, in a woman eighty-nine years of age, is recorded by Dr. Henderson,[2] and the same result in six weeks in the arm of a woman, in her eighty-seventh year, is noted by Paul.[1] Adverting to the supposed influence of old age in causing imperfection or failure of bony union, Dr. Wright thus gives his experience: "I have been frequently struck with the resources of the system in old age, as displayed in the prompt and perfect repair of injuries both of the soft and solid parts of the body. In the closing of wounds, the filling up and healing of extensive ulcers, and the firm reunion of fractures, it has occurred to me to observe all those processes accomplished with a facility and completeness scarcely exceeded at any age, in some instances where the subjects of such accidents had passed the eightieth year of life."[2] Bonn,[3] however, has furnished two observations, where advanced age appeared to be the only circumstance which retarded the formation of callus. Some idea of the influence of age in the production of false joint may be derived from an analysis of 112 cases extracted from our table, in which the age is noted.

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[1] Treatise on Anatomy, i. p. 27.

[2] Lond. Med. Gaz., Jan. 1843.

Of the age of 20 and under there were . . .	14
Between the ages of 20 and 30 there were . .	53
Between the ages of 30 and 40 " " . . .	21
Above the age of 40 " " . . .	24
	112

According to Larrey,[4] even the season and atmospheric temperature may exert some influence upon the consolidation of fractured bones; he relates that the gunshot wounds of the superior extremities complicated with fracture, especially those of the humerus, received by the French soldiers in Syria, although dressed according to art, were almost all followed by accidental articulation, which he attributes to the following causes:—

1st. To the continual motion to which the wounded were exposed after their departure from Syria, until their arrival in Egypt, and being obliged to travel mounted or on foot.

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[1] Lond. and Edin. Month. Journ., vol. i., 1841.

[2] Amer. Journ. of Med. Sci., iv. p. 273.

[3] Descript. thesauri ossium morb., p. 59, 61, 1783, quoted from Bérard's thesis, p. 7.

[4] Clinique Chirugicale, tom. iii. p. 459, 1830.

2d. To the bad quality of their food, and to the brackish water that they were forced to drink on this tedious journey.

3d. To the state of the atmosphere in Syria, that is almost deprived of vital air, and loaded with pernicious vapors arising from the numerous marshes near which they remained a long time.

The local causes which may hinder the consolidation of fractured bones, are various.

1st. *Frequent motion of the part.*—This may be owing either to indocility and perverseness on the part of the patient, to removing patients from place to place after these accidents, or to a want of a proper apparatus wherein to confine the fractured limb, or of skilful treatment. Too much motion from injudicious management of the fracture by frequent dressing, or the laying aside of splints, and the use of the limb at too early a period after the accident, may also give rise to it. Mr. Drummond, speaking of the little attention shown to severe injuries by the natives of New Holland, says: "The same indifference is shown to a fractured extremity unless it be a lower one, and that of the thigh, consequently no bony union is found to take place in such cases; and, indeed, at this period, both their sable majesties of the Sydney blacks are found to have artificial joints of the forearm."[1] Frequent motion of a fractured limb is the only cause of want of union mentioned by Celsus. Mr. Amesbury[2] considers want of rest to be more frequently the occasion of deficient union than any other, and considers it to have been the primary cause in almost all the cases which he had examined. The opinion that want of union is to be attributed most generally to some defect in our treatment, is held by Dr. J. R. Barton,[3] Liston,[4] Key,[5] Macfarlane,[6] Malgaigne,[7] and many other surgeons who have written upon the subject. Out of 44 cases extracted from the table appended to this paper, in which the occurrence of pseudarthrosis has been set down by the authors to some particular cause, 22 may, I think, from what is stated, be fairly attributed to motion in the fracture caused by neglect, or entire want of treatment. The information on this point, however, derived from the table, cannot be entirely depended upon, little or no attention seeming to have been directed to it by most of the reporters of the cases.[1]

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[1] Edin. Med. and Surg. Journ., vol. lvii. p. 118.

[2] Loc. citat., p. 197.

[3] Medical Recorder, ix. p. 276, 1826.

[4] Lancet, ii. p. 168, 1835-6.

[5] Lond. Med. Gaz., iv. p. 262, 1829.

[6] Edin. Med. and Surg. Journ., xlvii. 1837.

[7] Traité des Fractures, tom. i. p. 156, Paris, 1847.

The following cases are well adapted to show the effect of motion in retarding the union of fractures :—

A healthy seaman of good habits, ætat. 45, entered the Pennsylvania Hospital February 17th, with a fracture of the thigh near its middle part, which had occurred at Porto Rico, twenty-one days previously. The accident had been produced by a hogshead of sugar rolling over upon his limb, and had been properly dressed by a surgeon, soon after its occurrence. A day or two after his injury, the vessel to which he belonged sailed for this port, and from that time the treatment of the limb was superintended by the captain, the extremity being placed in a long fracture-box, extending to the groin, and the foot fastened by means of a handkerchief to a cross piece at its bottom, the fractured part being at the same time supported on its sides by pasteboard splints and thick pieces of sail cloth.

Upon admission, the limb was found to be free from swelling or excoriation. No callus appeared to have been thrown out around the fractured fragments, which admitted of much motion. The upper fragment was drawn outwards, and the lower was thrown inwards and a little upwards, the limb being about one inch shorter than that of the opposite side. In order to place the fragments in good position, and make moderate pressure over the thigh, Desault's apparatus was applied to the limb, though but little extension and counter-extension was made, and a full diet with porter was directed.

By the 14th of March a considerable mass of callus had been thrown out about the fracture, but there was still motion; pressure with pasteboard splints, moulded to the limb by previously wetting them, and firmly applied by means of a roller, commencing at the foot, was made use of, the long splints being continued.

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[1] To show how far this is the case, I may mention that in one instance (femur) the occurrence of false joint is attributed, by the gentleman reporting it, to an attack of cholera morbus, while it is stated at the same time that the patient, who was treated with Amesbury's apparatus, was suffered to move the limb as often as he liked, and to have his bed made every second or third day.

On the 26th, the union seemed firm, and the long splints were removed so as to allow the patient to move his limb about the bed, the pasteboard being continued.

On the night of the 28th, he re-fractured his limb at the point of previous injury, by turning over in bed during sleep, and entangling his foot in the sheet, in consequence of which the long splints were again employed. By the 17th of April, the limb was found to be again consolidated, when the apparatus was removed, and on the 7th of May he left the house with a good and very slightly shortened limb.

Another case of fractured leg of some standing, which had occurred and been treated at sea, ætat. 28, met with his accident on the 7th of November, by a blow from a cable. Both bones were fractured near the middle of the leg. He stated that ten days after his accident, ulceration over the injured part occurred, after which the bone protruded. On the 29th of November he arrived here, and was brought to the hospital, at which time the extremity of the upper fragment was protruding, and was removed by my colleague, Dr. Peace, the limb being afterwards placed and retained in a good position, in a fracture-box. About the middle of January, a small piece of bone came away, when the wound soon cicatrized, and on the 28th of March he was discharged cured, union having been firm for some time previously.

A third case of delayed consolidation after fracture of the leg, treated at sea, occurred in the person of a sailor aged 22, who was admitted on the 23d of March. His fracture was in the lower third of the limb, and had happened twenty-three days previous to admission, from a blow upon the part. The bones were quite loose when admitted, and some rising of the upper fragment was present. The limb was placed, properly supported, in a good position in a box, and a generous diet allowed. Pressure by means of pasteboard splints and a roller were after a short time applied, and by the 14th of April union was complete, and a large amount of callus surrounding the broken bones. The limb was now removed from the box, and on the 5th of May he left the hospital cured.

2d. *From the fractured ends being widely separate, or from their not being kept closely in contact.*—Where there has been a loss of substance, the nearer the ends of a fractured bone are laid, the easier will consolidation take place, and though want of union after fractures may undoubtedly follow the first of these causes, yet its occurrence in such cases is not constant. The length of bone that may be removed from fractured limbs and regenerated, often even under unfavorable circumstances, or in debilitated subjects, is truly astonishing. In the case of a boy, ætat. 12, who came under my care in the Pennsylvania Hospital in 1837, two inches of the tibia was removed, notwithstanding which he was discharged cured in eleven weeks with shortening of the limb of but half an inch, the space occupied by the removed bone being filled by a firm and even callus. Van Swieten[1] relates that he saw a fragment of the tibia four inches in length, removed after a fracture, and replaced at the end of ten months by a firm matter without shortening of the limb. Gooch[2] notes a case in which five inches of the tibia was lost, and supplied by solid bone. Mr. Phillips[3] mentions a young man in whom five inches had been removed with a similar result. La Motte[4] narrates two remarkable instances of a like kind, in one of which six inches of the tibia was removed after the accident, notwithstanding which the fragments were united at the end of eight months without shortening, by a firm callus. Many similar cases are to be found in the records of our science, and all hospital surgeons must have witnessed such, in a greater or less degree.

The consequence of want of close contact between the fractured surfaces is well seen in the patella, olecranon, and os calcis, all of which unite by bone when brought strictly in apposition, but, as this is in most cases impossible to effect, are found generally united by a fibro-ligamentous matter of greater or less length, according as the fragments have been more or less widely separated. The difficulty of retaining the bones in close contact in oblique fractures, is, in the opinion of many, a very common cause of deficient bony union. To place the fragments in contact in these cases, extension and counter-extension is kept up, and often the force exerted is in so great a degree as to cause suffering to the patient, and is by him, or his attendants, relaxed after the departure of the surgeon. At the following visit, displacement is found to exist, and in endeavoring to avoid deformity, the surgeon extends the limb. Pain ensues, and the apparatus is again loosened, and this is repeated until from the constant slipping of the fragments over each other, either the ends of the bone become smoothed off, and as it were cicatrized, with a large and misshapen callus thrown out around each extremity, or else bony matter is not deposited in sufficient quantity to surround the fractured ends, which continue loosely united by means of a fibro-ligamentous matter.

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[1] Commentaries, i. p. 514, § 343.

[2] Chirurgical Works, ii. p. 285.

[3] Lond. Med. Gaz., May, 1840.

[4] Traité de Chirurg., ii. pp. 575–579, 3d edit. 1771.

3d. *From disease of the fractured extremities.*—This is particularly the case in compound fractures where necrosis follows. In these injuries, if the periosteum be torn off from the ends of the bone, these parts at once lose their vitality, and the suppuration kept up around the fragments during exfoliation hinders union from occurring till a late period, in addition to which the long confinement necessitated by such a state exerts a noxious influence upon the constitution of the patient, and by this means still further retards the work of reparation. The case cited by Faivre[1] was of this kind. The seat of fracture was in the tibia, and had existed for seven months. A portion of the whole cylinder of the bone, one and a half inches in length, was found loose and was removed, and the ends cauterized with a hot iron; six months after which a perfect cure had taken place. Schmucker[2] also relates a case of fractured leg in which necrosis of a portion of the tibia followed, and no callus was formed at the end of eight months, a sinus remaining on each side of the leg. The sinuses, at the end of the time stated, were laid open, and the dead pieces of bone extracted, by which means the impediment to the formation of callus was removed, and the fracture became firmly united in two months. Sometimes, however, the necrosis is only the remote consequence of the injury. Pieces of bone are completely broken off at the time of accident, but still retain their life, and are embedded in the provisional callus, and when the fracture is almost consolidated these lose their vitality and act as foreign substances, giving rise to inflammation, which destroys in the course of a few days all the solidity of the callus, and postpones for a long time the cure. Mr. Amesbury[1] mentions his having seen a man with a fractured humerus accompanied with necrosis, in which no union took place, and the arm was amputated. I have myself had occasion to observe a fracture of the leg accompanied with caries, in an elderly woman, where union failed to occur, and amputation was performed by request of the patient. Hildanus,[2] Duverney,[3] Petit, Heister,[4] and many other authors, have recorded similar facts. Interesting cases in which the development of hydatids in the medullary canal prevented the formation of callus have occurred to Webster,[5] Wickham,[6] Dupuytren,[7] and a highly interesting case of the same nature occurring in the humerus, and cured by the seton, has been given by Mr. Crompton of Birmingham.[8] Amesbury[9] has seen the same thing follow the existence of abscess in the bone. Mr. Arnott[10] amputated the limb of a patient in Middlesex Hospital, in consequence of a fracture of the leg which had occurred in the situation of a node, and remained ununited at the end of a year: the fibula in this case was firmly consolidated. The general rule, however, that broken diseased bones will not unite, is not absolute. Dr. Peirson[1] has seen repeated instances of rapid consolidation in bones so diseased as to be broken by a very small degree of force. I had a patient, says Sir B. Brodie,[2] "in whom some of the bones had nodes upon them, and were much enlarged. A portion of the clavicle was enlarged, and much diseased besides. This man broke the collar bone through the diseased part. I bound up his arm, and it united as soon as ordinary fractures." In the following case treated by me at the Pennsylvania Hospital, want of union was evidently kept up by a necrosed state of the inferior fragment, after the removal of which a perfect cure was effected.

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[1] Ancien Journ., lxviii. p. 210.

[2] Verm. Chir. Schrif., quoted from S. Cooper.

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[1] Loc. cit., p. 197.

[2] Opera, 168, cent. ii. Obs. 66.

[3] Mal. des Os.

[4] Surgery, Trans. 1763, p. 128.

[5] New Eng. Journ., viii. p. 29, 1819.

[6] Lond. Med. and Phys. Journ., ii. N. S.

[7] Journ. Hebdom., xii. and ix., 1833.

[8] Lond. Med. Gaz., vol. xi., N. S., 1850.

[9] Op. cit., p. 197.

[10] Lond. Med. Gaz., June, 1840.

The patient was a healthy farmer from Clearfield County, Pennsylvania, aged thirty, who was received on the 9th of August, 1837. He stated, that on the 29th of May previously, a loaded wagon had passed over his arm and produced a simple fracture, which was dressed by a neighbor, with three board splints fastened tightly by a bandage around the injured part only. On the second day after its application, in consequence of violent pain at the seat of fracture, and great swelling of the hand and forearm, a physician was brought to him from a distance of many miles, who removed the dressings. Upon removal, the soft parts at the anterior and inner side of the arm were found to be mortified, and, in twelve or fourteen days afterwards, separated, and left the bone projecting some two or three inches. He suffered during this time from severe inflammation of the arm, accompanied by fever and a profuse discharge of pus; and after recovering in a measure his strength, he set off on foot for Philadelphia, where he arrived the evening before entering the hospital. The seat of fracture was found to be just below the insertion of the deltoid muscle, and the inferior fragment protruded through an opening only large enough to admit of its passage. The end of this fragment was of a yellowish-white color, and deprived of periosteum for the space of an inch or more, and not loose. No bony union had taken place. There was a small discharge of pus from the part, and no pain was experienced on handling and examining it. A good deal of hardening existed at the point of fracture, but it appeared to be rather from thickening of the different tissues, than from a deposit of callus. His general health was good. On the 30th of September the projecting portion of the bone was found to be loose, and was removed; after which the wound soon closed, and union begun to take place. By the 1st of November union was perfectly firm.

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[1] Remarks on Fractures, p. 38. Boston, 1840.

[2] Lond. Med. Gaz., xiii. p. 56, 1833.

4th. *The interposition of foreign bodies between the fragments* has been generally stated among the causes which may retard union. Portions of bone which are completely detached, bullets or other foreign substances, sometimes remain between the extremities, and by keeping up profuse and long-continued suppuration, so debilitate the system as to prevent the formation of callus, and give rise to this state. Rossi[1] notices a case of ununited fracture of the humerus, amputated by him after the resection of the extremities had been unsuccessfully resorted to, in which the cause of non-union was found to be a ball contained in the medullary canal a little above the false joint. In some rare instances, however, nature removes the irritating effects of the foreign body, by giving it a covering of dense fibrous structure. A remarkable instance in which this happened after fracture of the femur, is reported by M. Vogelvanger.[2] Two years after the accident the patient died, and M. V. found a piece of iron thirty-five lines in length, and five in breadth, completely surrounded by a deposit of callus.

Slips of muscle, or of tendinous matter interposed between the fragments, have also been stated as causes of want of union. That in some instances these parts are found lying between the fractured extremities there is no doubt, but that it ever proves in itself a cause of non-union, I am not disposed to admit. In all of the instances in which I find it mentioned as having existed, it is also stated that the fracture has been oblique, and the fragments more or less separated from each other. When this state of things exists, any soft parts in the neighborhood of the fracture are necessarily forced into the space between the bones, and so remain until a proper position is given to the limb and the fragments perfectly reduced; and where, from the size of the intervening part, this cannot be at once done, the mere continued pressure of the ends of the bone would, in a very short time, if properly adjusted, either cause its absorption, or else cause it to take on the ossific action. The interposition of any soft parts between the ends of a fractured bone, is justly regarded by Mr. Key[1] as a mere excuse for the occurrence of non-union. "It is the duty of the surgeon," he observes, "when he examines into the nature of the accident, and places the limb in splints, to ascertain that the fractured ends grate together; and if muscle is interposed, to make extension in order to disengage the broken extremity." The case mentioned in the Dictionary of Cooper, on the authority of Sir James Earle, is often quoted to show the possibility of muscular substance forming an impediment to the union after fractures. He says, "I have seen a woman, under Sir James Earle, in the above hospital (St. Bartholomew's), whose os brachii did not unite, though it had been broken several months. Every attempt to move the bone occasioned excruciating torture. The woman died of some illness in the hospital; and, on dissecting the arm, the cause of the fracture not having united was found to arise from the upper sharp pointed extremity of the lower portion of the broken bone having been forcibly drawn up by the muscles, and penetrated the substance of the biceps, in which it still remained." From this it is clearly evident that the fracture was oblique, and the fragments much displaced; and this want of apposition in the fragments is surely alone a sufficient cause for the non-union, without seeking for it in the interposition of muscular fibres between the fragments. Besides, it is well ascertained that muscles, as well as all the other parts surrounding a fractured bone, contribute more or less to the formation of the callus. An interesting preparation going to support this view, and much to the point in this particular matter, is mentioned in the *Dictionnaire de Médecine*, xiii. art. Fract., 2d ed., as having been presented to the Anatomical Society of Paris, in which the fragments of a clavicle, separated to the extent of an inch by the subclavian muscle, were united together very solidly by two bridges of newly-formed bone, in the centre of which the muscle, *itself ossified*, was imprisoned.

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[1] Thèse sur les Résections, by M. Roux.

[2] Gaz. Médicale, p. 445, 1838.

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[1] Lond. Med. Gaz., iv. p. 264.

5th. *Tight bandaging.*—That a tight bandage may prevent the restorative process from taking place there can be no doubt. Duverney[1] thinks nothing in simple fractures so much opposes the formation of callus as a too tight bandage. Paré[2] and Wiseman[3] also caution us in regard to its employment. Sir B. Brodie explains its *modus operandi*, by supposing that the fracture does not receive a sufficient quantity of blood to allow of the process to go on; but M. Malgaigne, with more reason, attributes it to the pressure preventing the deposit of the provisional callus. In support of the view of the latter it may be remarked, that Troja long since satisfied himself by experiment, that moderate compression in no way interferes with the process of reunion after fractures, but showed that a bandage tightly applied, without, nevertheless, being so much drawn as to cause any serious accident, prevented the formation of the provisional callus and its consequent consolidation.

6th. *The long-continued use of cooling applications*, by keeping down vascular action in the fractured part, is ordinarily given as one cause of tardy union. These applications should never be continued after the subsidence of the acute inflammatory symptoms. By Mr. Amesbury, diminished action from the too long continuance of sedative or cooling lotions, is regarded as a frequent cause of tardy union.[1] Dupuytren regards them in the same light.

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[1] Diseases of the Bones, trans. by Ingham, p. 171, 1762.

[2] Works, trans. by Johnston, p. 379, 1649.

[3] Chirurgical Treatises, ii. p. 256, 5th ed. Lond. 1719.

7th. *The too early use of a fractured limb* sometimes causes absorption of the callus to such an extent as to permit of motion in the part; and if in such instances the moving about is continued, the friction kept up between the ends of the bone causes them to become rounded, at the same time that the surrounding tissues become thickened, and form a false joint.

Though the above oftentimes cause the want of firm union after fractures, yet it must be confessed that want of consolidation occurs in some instances, without our being able to trace it to any particular cause. One of the most authoritative writers on the subject of ununited fractures, is unwilling to admit that in these cases, a cause cannot always be found. On this point, he thus expresses himself: "I have examined fifty-six cases of non-union, exclusively of those which I have witnessed in the neck of the thigh-bone, olecranon, and patella. The constitutions of three of these were decidedly bad; another had been much reduced by cholera, during the recent state of the fracture. The remaining fifty-two, apparently, possessed constitutions, and enjoyed health equal to the most vigorous and healthy individuals that came under observation." "In these cases, with the exception of two which occurred during pregnancy, where constitutional causes might, under any treatment, have operated in a measure so as to retard the union, I think the cause was purely local; and for the most part, if the treatment had been such as to secure the fractured parts in proper apposition, and in a state of quietude, the fractures would have united at an early period."[2] The experience here given is valuable, though allowance is to be made for any mere opinion on this subject from its author, inasmuch as this theory of the cause, or mode of production of ununited fractures, was brought forward to support arguments for the use of his peculiar apparatus in the treatment of these accidents. Equally good observers, and

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[1] Op. citat., p. 198.

[2] Amesbury, loc. citat., p. 202.

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careful practitioners, differ in belief from him, and that it sometimes happens that no firm union will take place in persons enjoying apparent perfect health, even when regularly and judiciously treated, must be admitted. An instance of ununited fracture is mentioned by Mr. Samuel Cooper[1] which occurred in a strong and robust man, whose chief peculiarity seemed to be his indifference to pain, where the ends of the humerus were cut down to, turned out, and sawn off by Mr. Long, in St. Bartholomew's Hospital, and the limb was afterwards put in splints, and taken the greatest care of; but no union followed. He also notices another case of a broken tibia and fibula, occurring in a subject who was a complete instance of hypochondriasis, which remained disunited for about four months; but afterwards grew together. M. Sanson[2] cites three cases of fractures, one of the leg and two of the thigh, that required from five to ten months of treatment before union was perfect; and two cases of false joints in the thigh, in which it was impossible to attribute this state of things to any appreciable cause. Latta states that he had met with three instances of fractures purely transverse, in which, notwithstanding all the care that could be taken, no callus was formed.[3] Ruysch and Van Swieten have reported several like facts, and other cases might readily be brought forward.

So often indeed, does non-union occur after the most regular treatment, that we should be cautious in ever attributing this state of things to any fault of the surgeon. That want of care in the treatment on the side of the practitioner, or restlessness on the part of the patient, does not hinder the formation of callus in large quantity, must have been noticed by every one. In bad compound fractures, the large discharge of matter from the wound not unfrequently requires that the limb be daily moved, and the fragments are consequently much oftener disturbed than occurs in the treatment of simple fracture, and yet false joint is not as frequent in the former as the latter class of cases. How often do we see cases that have been carelessly treated, or even entirely neglected, where union, though attended with deformity, takes place? How often where two bones existing in the same limb have been fractured, do we find that one will unite and the other not? How many cases too have been observed, where more than one fracture has existed in the same individual at the same period, and where, though all be equally well treated, want of union will follow some one of them? One instance I have seen recorded where the humerus was broken in two places, the upper one of which united firmly, and the other did not. If non-union depended generally upon want of perfect rest in the injured part, the bones that are with most difficulty retained in apposition after fracture, are those in which we should expect most frequently to meet with it. The clavicle, comparatively speaking, is rarely the seat of ununited fracture, and yet did it depend upon mobility, that bone of all others, is the one we should find most frequently affected with it. The ribs we daily see well united after fractures, despite the constant motion to which they are subjected in respiration. In animals, Sir B. Brodie[1] asserts, that he has tried, over and over again, to prevent union by giving motion to the broken bones several times a day, but has never succeeded, and, indeed, thought that union seemed to go on more rapidly where the limbs were thus exercised than when they were not disturbed. Union, however, we know takes place with great facility in animals, and the knowledge of this fact proves of itself nothing conclusively in regard to fractures in man; but surely the known uniformity of nature's laws, when taken in connection with the facts we have just adduced, should make us pause before positively asserting that motion is always the cause of ununited fractures—more especially when, as is sometimes the case, an opinion is required which may irreparably injure a fellow practitioner. Causes may be suggested for this state of things, some of which may seem plausible, or be shown to be true with regard to particular instances, but in many cases its occurrence cannot be satisfactorily accounted for. In the words of Sir James Paget,[1] it "sometimes appears like a simple defect of formative power; a defect, which, I believe, cannot be explained, and which seems the more remarkable when we observe the many changes which may at a later time be effected, as if to diminish the evil of the want of union." That the state of the constitution has considerable influence over the process of reparation in fractured bones, none can deny—where the lancet has been largely used after the accident, where patients are much debilitated, or are laboring under constitutional diseases, the process may be retarded; but where the peculiarity of constitution which renders the vessels of the injured part incompetent to furnish bony matter does not exist, we find generally the deposit of callus to take place, upon this morbid state of system being removed. Schmucker[2] found the formation of callus, even in the most simple fractures, sometimes delayed eight months, and in one example, more than a year; but all the patients were unhealthy. Even after a fractured limb has become perfectly firm, and is surrounded by a large mass of callus, it is possible for it to become softened, or even entirely absorbed, during an attack of general fever, erysipelas, or other acute affection. I have in two or three instances witnessed the first of these effects produced by attacks of erysipelas in compound fractures, when the disease has prevailed generally in the wards of the Pennsylvania Hospital; and in one instance of simple fracture have seen a rapid absorption of a large callus, which had produced firm union of a fracture of the lower third of the leg, occur without any apparent cause, to such an extent, as to render the fragments very movable, and necessitate a renewal of the treatment. This absorption, or softening of the callus, has been observed by Mead,[3] in a sailor, attacked by scurvy, in whom, three months after firm union of a fractured clavicle, the callus became softened and gave way; in this case the general affection is stated to have retarded for more than six months any new union. In speaking of the ravages of the scurvy during his voyage, Lord Anson makes mention of a man on board the Centurion, in whom "the callus of a broken bone which had been completely formed for a long time was found to be dissolved, and the fracture seemed as if it had never been consolidated." Another like instance has been recently observed by Dr. Budd.[1] We find recorded by Desault,[2] the case of a fractured femur occurring in a woman, aged 82, where consolidation took place by the seventy-fifth day, but in whom, two months after, death occurred from severe diarrhœa, and the callus was found completely softened. Morgagni[3] quotes from Salzmann, the case of a soldier with fractured tibia, in whom union had become so firm as to allow of his walking upon the limb without difficulty; but during an attack of fever, eight months afterwards, the callus was noticed gradually to disappear, so that the ends of the bone became separated. After convalescence, the parts again became firm. Dr. Schilling has seen the callus deposited around the ends of a fractured femur, which had become so firm as to allow the patient to bear some weight upon the limb, completely absorbed during an attack of typhus abdominalis. Ten days after the symptoms set in, callus could no longer be felt, and the bones moved as easily upon one another as immediately after the reception of the injury. In six days more the patient died. The examination showed no trace of callus, the broken surfaces were bloody, like those in a recent fracture, and were surrounded by a sac-like membrane, which contained some black bloody fluid.[4] Mr. Mantell has published the case of a youth, aged seventeen,[5] who, some weeks after the perfect cure of a fractured leg, was seized with a severe attack of fever, and upon first leaving his bed after the subsidence of it, the limb bent under him in consequence of the callus having become soft, and giving way. As recovery from the fever proceeded, new callus was formed and reunion of the fracture was effected, though with much

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[1] Dictionary, ed. 1838, p. 551.
[2] Dict. de Méd. and Chir. Prat., iii. p. 494.
[3] System of Surgery, iii. p. 362.

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[1] Loc. cit., p. 57.

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[1] Surgical Pathology, Lond. 1863, p. 193.

[2] Vermischte Chir. Schriften., quoted from S. Cooper.

[3] Medical Works, p. 442.

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[1] Tweedie's Cyclopedia—Art Scurvy.

[2] Journ. de Chirurg., i. p. 243.

[3] French Translation, ix. p. 159, Paris, 1820.

[4] British and Foreign Med. Review, 1840.

[5] Lancet, i. 1841–2, p. 58.

deformity of the limb. In the thesis of M. Bérard, I find another instance, quoted from Bonn, where fever with inflammation and gangrene, occurring in an old man, who had suffered from fracture of the femur that was firmly united, produced absorption to such an extent, as to allow the fragments to become movable one upon the other. Dr. Penel,[1] Surgeon to the Civil and Military Hospital at Abbeville, furnishes the case of an elderly man with fractured thigh, in whom, on the fortieth day, union being solid, the dressings were removed, and the limb laid on a bolster; but suddenly the callus was destroyed, and it was necessary to make continued extension to reduce the fractured bones: at the same time the urine was observed to deposit a considerable quantity of a greenish substance, which on examination was found to be phosphate of lime. The fracture seemed again to consolidate, the urine however remained the same, and was passed in a greater quantity. Two months after the fracture, the callus appeared a second time firm. The dressings were continued twenty days longer; but two days after their removal, the extremities of the fracture separated, and it was necessary again to make the reduction. He now gave the patient ʒss of nitric acid daily, when the urine became clearer, and four months after his first reception the dressings were removed and the limb found to be firm. From some cases published by M. Guyot,[2] it appears that an inflammatory action in the callus alone, unaccompanied by any other affection, and ensuing several weeks after the accident, occasionally produces softening and absorption of the newly formed bone, and ultimately disunion of the ends. Duverney,[3] Malgaigne,[4] Wardrop,[5] Kirkbride,[6] Laugier,[7] Guersant,[8] and Vidal, have all witnessed cases of absorption of the callus, in acute local disorders. This softening, or absorption, however, affects the provisional callus alone, and is consequently seen only in the first few months that follow a fracture; at a later period, when the definitive callus is completely formed, the bone becomes more dense and firm than it originally was, and is never absorbed. The following well-attested case, in which not only the callus resulting from a fractured humerus but the whole bone was slowly absorbed, is, we believe, without parallel in the records of surgery.

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[1] Lond. Med. and Phys. Journ., xiv. p. 29, 1805.

[2] Arch. Gén. de Méd., Feb. 1836.

[3] Op. citat., preface.

[4] Lancette Française, iii. p. 217, 1830.

[5] Med. Chir. Trans., v.

[6] Amer. Journ. of Med. Sciences, xv. 1835.

[7] Des Cals Difformes.

[8] Gaz. des Hôpitaux, Dec. 1842.

Mr. Brown, residing in Derne St., Boston, aged 36, when in his eighteenth year fractured the right humerus near the middle. Under the care of a judicious surgeon, a reunion was favorably going on; but, before the curative process had been completed, the patient had another fall, and again broke the arm at the seat of the old fracture. Notwithstanding every care, the divided extremities would not adhere; and, to the surprise of the medical attendant, the shaft of each part of the divided bone began to diminish in size, and shorten in length. By a gradual action of the absorbents, the whole of the arm bone, between the shoulder and the elbow, was at length completely removed, and that, too, without any open ulcer, so that not a vestige of it was left. Mr. B. now, after many years, presents the spectacle of one short and one long arm. The right forearm and hand are of a size to correspond with the sound one on the left side, and under certain circumstances are equally as strong. Ordinarily the right arm swings hither and thither, like a thong with a weight at the extremity; for the forearm and hand, with reference to the division above the elbow, constitute a pendulum, oscillating according to the movements of the body. Although it is impossible to push with the defective arm, he can draw a burden towards himself with it as strongly and tenaciously as with the other; and in so doing, the muscles are elongated, so that the arm is extended to its original length; when the resistance is removed, the muscles instantly shorten themselves about six inches. To show the perfect non-resistance of the apparatus of muscles, arteries, veins, and nerves in the soft, boneless space, we saw him twist the palm of the hand twice round, which consequently presented the strange anomaly of having all the apparatus of the arm twisted like the strands of a rope.[1] The subject of this singular case died in the Boston Lunatic Asylum, of pneumonia, on the 11th of February, 1871, at the age of 70. He had been an inmate of the institution at intervals for four years and three months, but except in mental condition, was, as he had always been, in excellent general health, with no local affection of his osseous system except the arm alluded to, and capable of a very considerable amount of manual labor. For four years after his fracture Mr. B. did no work, but the process of absorption covered a period of twelve years, at the end of which time the limb had attained a condition in which it permanently remained until the day of his death. He could hoe, rake, shovel, sweep, cut wood, carry a large pail of water, hold a knife at the grindstone, and write a good hand. By twisting the upper part of his arm, he could use his fingers well enough to tie his neckhandkerchief. The muscular power of the arm was very considerable. The dissection, which is minutely described by Dr. C. B. Porter, showed all traces of the humerus to be obliterated, except its two extremities, the lower one being an inch and a half long, and the remains of the upper extremity consisting of a thin auricular-shaped plate of bone, two inches long and one wide, in close relation with the articular cavity, but presenting no articular surface.[2]

Cases of pseudarthrosis sometimes occur which occasion so little inconvenience as scarcely to interfere with the use of the parts in which they may be situated; and under such circumstances, it is more than doubtful whether any operative means should be recommended for their cure. In the *Nouvelles de la République des Lettres*, of Bayle, a case is recorded by Sylvestre, in which an ununited fracture of the forearm, four inches above the wrist, in no way prevented good use of the limb. Sue[3] mentions a case of fractured femur which never united, where during a period of eleven years the patient enjoyed good health, and walked about easily with the aid of a cane. Mr. Crompton[4] saw an ununited femur, close above the knee-joint, where the man could walk pretty well by the aid of a strong leather case, and on that account, as well as because of the close proximity of the fracture to the joint, recommended nothing to be done. Kuhnholtz[1] has given an instance in which an ununited fracture, situated in the thigh, interfered but little with the use of the limb. MM. Sanson[2] and Yvan[3] have seen like cases. A patient came under the notice of M. Cloquet,[4] in whom the upper fourth of the humerus had been lost, without in any way interfering with the motions of the arm. Another instance in the same bone in which all the motions of the arm could be performed, though it was weakened and the patient was not sure of his motions, is furnished by Brasdor.[5] M. Velpeau[6] noticed some years since, at La Pitié, a man with an ununited fracture of the clavicle, in whom all the movements of the arm were executed without difficulty. M. Gras[7] gives an instance of an ununited fracture of both bones of the forearm, at the inferior part, from gunshot, which gave so little inconvenience that no operation was attempted, and Mr. Marshall (*On Enlistment*) mentions the instance of a recruit with a false joint in the same part, who passed the usual examination as to his physical condition. Horeau[8] has furnished a case situated in the lower jaw, in which, although mastication was somewhat affected, yet was so little annoying, that the patient was not willing to undergo any treatment for it. Mr. Syme[9] has seen want of consolidation in the humerus and forearm, where the fracture was transverse, accompanied with very little inconvenience. I have myself seen a young Irish woman with an ununited fracture of the clavicle, in which, although great motion existed between the fragments, so little inconvenience was experienced, that it was not judged proper to resort to any treatment for it; and in 1839 a case of false joint in the radius, two and a half inches above the wrist, came under my notice, where the patient enjoyed excellent use of the member, and notwithstanding some deformity, was able to work at his trade (that of a tailor) as well as if no accident had happened; and a few years since was consulted by a muscular man with a non-united humerus at the insertion of the deltoid, which allowed of good, though not perfect, use of the member without any artificial support.

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[1] Boston Med. and Surg. Journ., July, 1838, p. 368.

[2] Boston Med. and Surg. Journ. for October 10, 1872.

[3] Maladies des Os.

[4] Lond. Med. Gaz., vol. xi., N. S., 1850.

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[1] Journ. Complémentaire, iii.

[2] Velpeau, Médecine Opératoire, i. p. 599, ed. 1839.

[3] Archives Gén. de Méd., xix. p. 619.

[4] Archives Gén. de Méd., xix.

[5] Mems. de l'Acad. de Chirurg., tom. v. p. 381, 8vo.

[6] Gorré. Thèse, No. 218, 1835.

[7] Journ. de Méd. Chir. and Pharm. in 40 vols. viii.

[8] Journ. de Méd. Chir. and Pharm. x.

[9] Edin. Med. and Surg. Journ., July, 1835.

Even in cases where the want of bony union in fractures has not permitted the patient to make use of the limb, we often find that by the employment of simple means the defect may be rendered supportable. M. Troschel[1] mentions three instances in which, by the application of tin splints fitted to the limbs, the persons were enabled to walk without difficulty. Monteggia (iv. p. 28) relates the case of a monk in whom existed a non-consolidated fracture of the middle of the forearm, and who, by means of an appropriate apparatus, could make use of it for all ordinary purposes. Briot[2] notices the cases of two soldiers in whom fractures of the arm had not become consolidated, where well-padded splints of sheet-iron, so formed as to surround the limb, diminished considerably the inconvenience resulting from the non-union, and in another case of a laborer, which had existed for twelve years, good use of the member was obtained by like means. M. Velpeau[3] examined an ununited fracture of the thigh in a female, who, with the aid of a clumsy apparatus, continued to make good use of her limb. Delpech[4] has seen a workman with a non-consolidated fracture of the femur, who, by means of a case for the thigh, was enabled to pursue his usual employments. Mr. Linton[5] furnishes the case of an Arab sheik, affected with a fracture of the right humerus, accompanied with great loss of bone, that had never united, in which a circular silver tube, six and a half inches in length, was worn with ease, and permitted him to do good service with his sword. Dr. Betton, of Germantown, mentioned to me an instance which came under his notice, in which no union had occurred after a fracture of the humerus, where a pasteboard splint, made so as to surround the arm, was worn with such good effect as to allow the man to apply himself to his usual employment. In his retrospective address in surgery, delivered at Liverpool in 1839,[1] Mr. James mentions, that having failed in obtaining union of the bones of the upper arm by excision of their ends, in a case where a seton could not have been passed, he had recourse to an external apparatus, which appeared to answer the purpose of giving stability to the limb so well, that he "should feel very reluctant to undertake a severe operation again for this defect, unless on further trial the apparatus was not found to succeed." Larrey[2] even goes so far as to recommend in all cases of fracture, where the usual means are insufficient to effect consolidation, that they be left to nature. The patients, he says, accustom themselves to this infirmity, of which the effects diminish with time and exercise, and they finish by being able to use the affected limb with the aid of a pasteboard splint to envelop it; three cases are related by him, all of whom, despite the existence of false articulations in the arm, were able to perform the ordinary duties of soldiers. More lately, the same surgeon has exhibited to the Academy of Surgery[3] an invalid affected with a disunited fracture of the femur in its middle, of several years' standing, where, although the member was shortened, and the fragments very movable, the patient, by means of a high-heeled shoe, made use of his limb without the aid of crutches. Instances have occurred in the leg, where, one of the bones only being broken and remaining disunited, the other has become enlarged to such a degree as to support well the whole weight of the body. A very remarkable example of this sort, in which the tibia remained ununited, while the fibula, which had remained perfect, increased exceedingly in size, and performed the office of the tibia in supporting the body, is mentioned by Dr. South[1] as having been in the museum of St. Thomas's Hospital, and Sir Astley Cooper, in his work on Fractures and Luxations, figures a case of a similar kind. Such instances are rare.

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[1] Journ. des Progrès, x. p. 257.

[2] Hist. de la Chirug. Militaire, 1817.

[3] Op. cit., ii. p. 582.

[4] Dict. des Sci. Médicales, iii. art. Cal.

[5] Lond. Med. Repository, Feb. 1824, p. 93.

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[1] Provin. Med. and Surg. Trans., viii.

[2] Clin. Chirurg., iii. p. 461.

[3] Dict. de Médecine, xiii. p. 492, 2d ed.

In the majority of cases, however, the extremities affected by pseudarthrosis become almost useless, and resort to curative means is demanded by the patient. As late as 1763, Legrand reported to the Academy of Surgery of France, three observations of want of union for which he was at a loss to suggest any operative procedure,[2] and up to the time of White, in 1760, so few were the cures by the methods then in use, the majority of persons laboring under these affections had only the choice of retaining a useless limb, or of having it removed by amputation; but now, thanks to the progress of our science, many different methods are offered for their relief, of which the following are the principal:—

1st. *Friction*, or rubbing the extremities of the bone against each other. This method is mentioned by Celsus, and appears to have been that usually adopted by the surgeons of his time. "If the fracture be of long standing, the limb is to be extended, in order to produce a fresh injury: the bones must be separated from each other by the hand, that their broken surfaces may be rendered uneven by the grating against each other; and if there be any fat substance, it may be abraded, and the whole reduced to the state of a recent accident; yet great care must be employed, lest the ligaments or muscles be injured."[3] John Hunter recommended it. In some cases where the union is delayed, the mere removal of the splints and leaving of the limb free and without apparatus of any kind will produce sufficient action in the ends of the bone to bring about firm union. Sometimes the friction is made by seizing the extremities of the bones, and strongly rubbing one against the other; this is to be done daily until the parts

[1] Otto, loc. cit., p. 224.

[2] Journ. de Desault, tom. ii.

[3] Liber 8, Cap. 10, Lee's Trans., ii. p. 422.

become painful, when the ordinary apparatus is to be applied for the purpose of keeping the fracture in a state of perfect rest. At the end of ten or twelve days the limb should be examined, and if union is not excited, or at least some stiffening have been produced, the process is to be again repeated. Another method, often resorted to in the lower extremities, of making frictions of the ends of the bones, consists in enveloping the limb in pasteboard previously softened, a leather case, or other suitable apparatus, and then suffering the patient to move about and bear weight upon it as usual, in order that the friction, the "stimulus of exercise," should bring about such a degree of irritation as would lead to the deposit of callus. Mr. White of Manchester in 1768 was the first to employ friction by pressure and motion. Being consulted by a patient in whom the femur had not united at the end of five months, he advised the use of a case of strong leather, properly lined and stuffed, and so made that when laced it enveloped the whole thigh, and kept the fragments extended and in apposition. After its application the man was made to get up and endeavor to walk by the help of crutches. After the apparatus had been worn for some time, the thigh began to swell, and, about three months after the treatment was begun, a large abscess appeared and was opened, by which time perfect union had taken place.[1] In three instances Mr. Inglis employed a case very similar to that of White; in one of these the femur was interested, and some months after the patient's discharge from the hospital wearing it, "he returned with the case in his hand to restore it, and to show that by its means he had been completely cured."[2] Troschel[3] has described and figured an apparatus for the same purpose invented by Baillif, a Prussian mechanician, and details three instances in which it was used; in one of them, where the false joint was in the middle of the thigh, the patient could walk, with the aid of a cane, twenty miles a day. Several cases of delayed consolidations, where a similar treatment was resorted to, have been also reported by Dr. H. H. Smith of this city.[1] A state of perfect rest, however, it should always be remembered, is necessary to the proper and speedy union of fractured bones; and this fact should not be forgotten in the application of the treatment here mentioned, to the cure of ununited fractures, so that, so soon as the proper degree of irritation is once effectually produced, the patient should be placed in a state of quietude, and his affection treated as a recent injury. The continuance of exercise, or frictions, after the occurrence of irritation, would retard rather than accelerate the firm union of the fragments.

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[1] Cases Surgery, p. 76, 1770.

[2] Edin. Med. and Surg. Journ., vol. i. 1805.

[3] Journ. des Progrès, 1828.

2d. *Blisters applied to the seat of fracture* were proposed by Mr. Walker, of Oxford, in 1815.[2] This method is peculiarly adapted to cases which are tardy in uniting. They appear to act by exciting the periosteum, and parts about the fractured ends, to increased action; and the same effect may be produced by an attack of inflammation in the limb. An interesting instance of the effect of this latter is given by Seerig.[3] The patient, who had refused all treatment, was seized, without any apparent cause, with erysipelas of the limb, which produced its consolidation. Mr. Wardrop[4] mentions a case of fractured humerus, where union went on rapidly after contusion of the part, although there previously seemed to be no disposition towards it. Dr. Kirkbride[5] also mentions a case in which an attack of erysipelas, after the passing of a seton, appeared to hasten considerably the consolidation of the bone. Another instance, in which the inflammation produced by an accident was sufficiently great to cause consolidation of an ununited fracture, is reported by Mr. Amesbury.[6] "A gentleman had a fracture in the thigh, in which no union could be produced. Several months after his accident he was thrown out of his gig, and the wheel passed over the limb at the fractured part. He was confined after the second accident, which was followed by high inflammation; and now the fractured bone united."

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[1] Amer. Journ. Med. Sci., vol. xxix. N. S. 1855.

[2] Lond. Med. and Phys. Journ., xxxii. p. 470, 1815.

[3] Quoted from Archives Générales for Jan. 1839, p. 105.

[4] Med. Chir. Trans., v. 1814.

[5] Amer. Journ. of the Med. Sciences, No. xxxiii. 1835.

[6] On Fractures, 2d ed. 1829, p. 210.

Sir B. Brodie[1] asserts that he has found very great benefit from the use of blisters, in cases which are not of long standing. In cases of tardy union, to which they are particularly applicable, I have, in more than one instance, witnessed a very rapid deposit of callus after the application of blisters to the seat of fracture. From the nearness of the tibia to the surface, their employment is peculiarly adapted to fractures of this bone, and are much more likely to prove successful in it, than where the bones are deeply covered with soft parts. Even in the superficial bones, however, they sometimes fail. An instance of this kind, occurring in a lady who had a fracture of the tibia at the small of the leg, in which they were tried for a long time without benefit, is mentioned by Amesbury.[2] Mr. Walker made use of blisters of small size, and repeated their application as often as five or six times. Velpeau recommends that they be sufficiently large to surround the limb. In those instances in which I have witnessed their employment, they were made of such size as to cover completely the seat of injury. Sinapisms are an equally efficacious means of inducing irritation, and on some accounts are preferable to the use of blisters.

3d. *Iodine.*—The treatment of non-union after fracture, by the application of iodine to the injured part, was first proposed by Mr. Buchanan, of Hull, in 1828.[3] He applied it in the form of tincture, by daily painting over with a small brush the parts covering the false joint. In the case reported by Mr. B., the Hunterian method was, at the same time, resorted to, and a perfect cure was obtained in four months, though the Hunterian method alone had been unsuccessfully tried previously to the application of the iodine, for six months. The same remedy has been since made use of with good results by Mr. Crosse[1] and Dr. Willoughby.[2] According to Oppenheim,[3] it has also been successfully repeated by Trusen, in Germany. The efficacy of the iodine in these cases can only be owing to its stimulating properties; and in some instances of slow union, where blisters are objected to, it might be worthy of trial.

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[1] Lond. Méd. Gaz., xiii. p. 57, 1833.

[2] Loc. citat., p. 212.

[3] On a New Method of Treatment for Diseased Joints and the non-union of Fractures. London.

4th. *Compression and Pressure and Rest.*—Mr. Inglis, in 1805,[4] adopted this plan of treatment. In his case a considerable degree of pressure was made over a tin-plate, placed over the seat of fracture, by means of a roller. In this instance, however, as also in one which occurred several years previously to White, in which nearly a similar plan of treatment was pursued, the pressure was combined with frictions, the patients being permitted to move about after the application of it. Pressure, conjoined with perfect rest, or, as it has been termed, still pressure, was first proposed by Mr. Amesbury, and has been highly lauded by Dr. Wright, of Baltimore. In some instances it has been produced by means of the peculiar apparatus of the former of these gentlemen for the treatment of fractures, while in others, it has been applied by means of a tourniquet passed around the seat of injury, the part being previously enveloped in splints or the immovable apparatus. We are totally without facts to show that pressure and rest alone are sufficient to bring on such a degree of action as is necessary to produce union where the pseudarthrosis has been of long-standing, and is itself unaccompanied by inflammation of the periosteum or parts about. It cures solely by immovability, and is consequently only applicable to such cases as occur within the period in which the permanent callus is produced.

In the following case, treated by me at the Pennsylvania Hospital, a rapid cure was effected by this mode of treatment. The patient, aged 50, was admitted Sept. 14th, 1839, with a fracture in the lower third of the femur of seven months' standing; the leg of the same side, which had also been fractured by his accident a little below the knee, had firmly united. The lower part of the thigh was enlarged, owing to the callus thrown out around the seat of injury, and was much bent outwards and shortened. He was unable to bear his weight upon the limb, and upon attempting to do so the motion of the lower upon the upper fragment was very evident, both to the patient and observer. Strong extension had no effect in bringing down the limb to its natural length, and the treatment was directed with a view of producing union by compression and rest. For this purpose, a roller being first applied, strong pressure was made over the projecting portion of the bone by means of a bandage secured to a well-padded long splint placed upon the inner side of the limb, the bandage being reapplied every few days. At the end of a month the deformity was evidently less and the union firmer. The apparatus was reapplied, and, in order to keep up as much pressure as the patient was able to bear, a tourniquet was placed over the point of fracture. On the 31st October the limb was found to be less deformed from absorption of a portion of the large mass of callus which surrounded the seat of injury, and quite solid.

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[1] Lond. Méd. Gaz., vi. p. 512, 1830.

[2] Trans. of Med. Soc. of State of N. York, i. p. 76, 1834.

[3] Loc. citat., p. 3.

[4] Edin. Med. and Surg. Journ., i. 1805.

By means of a tourniquet over the splints an equable degree of pressure can be kept up; and if pain or other unpleasant symptom follow, its application may be removed without putting the surgeon to inconvenience.[1]

5th. *Electricity* has been employed with good effect by Mr. Birch, of London. One of the pupils of this gentleman informed Dr. Stevens, of New York, that he had seen two cases in which it produced the most happy effect. One of these cases was seated in the leg, and was of thirteen months' standing. "Shocks of electric fluid were daily passed through the space between the ends of the bones, both in the direction of the length of the limb and that of its thickness. The man, being somewhat weak, used bark and porter at the same time. The leg was retained in the ordinary fracture-dressing. Improvement was very perceptible in two weeks, and in six weeks he left the hospital cured."[1] Two cases, however, have been reported by Dr. Mott,[2] in which "very powerful shocks of electricity were passed in different directions through the part" without benefit.

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[1] Amer. Journ. Med. Sci., vol. xxv. p. 273, 1839.

6th. *Salivation.*—This method of cure for disunited fractures was employed successfully in 1830, by Sir Stephen Hammick. Speaking of the cure of these fractures, this author says, "Mercury will frequently be required by patients who never had any syphilitic taint, not only to act as an alterative, but even it will be necessary to push it to a considerable extent before union of a fractured bone will take place."[3] Mr. Colles, of Dublin, has also seen cures take place in these cases, by the administration of mercury; and in an instance that he witnessed at Guy's Hospital, in 1836, under Mr. B. Cooper, which had proved rebellious to other modes of treatment (seton, frictions, and the immovable apparatus), he suggested its trial to that gentleman.[4] The patient was a healthy female, æt. 28, and the fracture, which was at the humerus near its middle, was of six months' standing. Four weeks after the removal of the seton, salivation was produced by the administration of four grains of hydrargyrum cum creta, three times a day, and at the same time a leathern girth was firmly applied over the seat of fracture. The girth was removed at the end of a month, and a perfect cure was found to have taken place. In this instance, we are disposed to attribute the cure as much to the pressure over the seat of fracture made by the leathern band, as to the administration of mercury; and this view of the case we are the more inclined to adopt, as we find that three months after cure, she re-entered the hospital, with a fracture of the same arm below the part at which it was first broken, which, by the application of the same girth, was cured in the usual period. In the *Cyclopædia of Practical Surgery* (art. Fracture), a case treated by mercury is mentioned by Mr. Adams. The patient, aged 26, had, five months' before, broken the femur near the trochanter. He was on the use of blue pill till his mouth was made sore; then on sarsaparilla, nitro-muriatic acid, and a nourishing diet. A spica bandage was applied around the pelvis and upper part of the thigh, and over this a starched bandage from the toes to the groin. The bandages were renewed two or three times for the purpose of ascertaining the state of the parts. Two months after the mouth had been made sore, consolidation had manifestly advanced, and about three months after his admission the bone was sufficiently firm to admit of his going into the country. Professor Sigmund, of Vienna, has met with five cases where syphilitic patients have sustained fractures while undergoing mercurial treatment—the radius twice, the fibula, clavicle, and the humerus. Complete union in the usual time occurred in all these cases. In none of them was the mercurial treatment discontinued, nor any change made in the diet. In a case at the Middlesex Hospital of London, Mr. Arnott failed to effect a cure by mercury, and Mr. Charles Hawkins asserts, that he has seen mercury freely administered in three cases that had come under his observation, without benefit.[1]

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[1] Transl. of Boyer by Stevens—note.

[2] Med. and Surg. Reg., part 2, i. p. 375.

[3] Lectures on Fracts., Amps., etc. p. 118.

[4] Guy's Hospital Reports, ii. p. 399, 1837.

7th. *The application of caustic alkali to the integuments over the seat of fracture.*—In 1805, Dr. Hartshorne, of this city,[2] successfully employed this practice in a case of ununited fracture of the external condyle of the femur of four months' duration, and in 1811, he applied the same practice to a disunited humerus of about five months' standing, with the effect of partially relieving the patient; in this last case the issue was three inches long and one wide. A third case occurring in the femur, about which he was consulted in 1838, was cured by the caustic conjointly with pressure.[3] An eschar three inches long by one wide, made on the arm with the caustic potash, where the injury was of six months' standing, proved ineffectual in a case which afterwards came under the care of Dr. Hays.[1] The actual cautery has also been employed in these cases. As with the application of blisters, and moxa, these means are particularly adapted to instances of tardy union, and in bones seated superficially, as the tibia and ulna, and the condyles of the femur.

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[1] Lancet, ii. 1839, 1840, p. 382.

[2] Eclectic Repertory, iii. p. 114, 1813.

[3] American Journ. of Med. Sciences for January, 1841, p. 143.

8th. *Seton.*—Writers generally have asserted that the mode of treating false joints with the seton was proposed by Winslow, but a reference to his publication shows the statement to be erroneous.[2] He used the seton in a case of necrosis accompanied with a fistulous opening, with a view of hastening the exfoliation of the diseased bone. Percy, in 1799, employed it with a similar view. The treatment of false joint by the seton originated with Dr. Physick in 1802, and the first case in which it was used is recorded in the *Medical Repository*, vol. i. The fracture was seated in the humerus, two and a half inches above the elbow, and was received on the 11th of April, 1801. The fragments passed each other about an inch. On the 18th of December, 1802, a seton was passed between the fragments of the bone. The pain of the operation was moderate, and the inflammation that followed was not severe. For the first twelve weeks there was no evident abatement of motion, but after this time it became gradually more stiff, and by the 4th of May, 1803, it was perfectly firm, and the seton was removed. Some time afterwards, Percy of France treated a non-united fracture of the femur by the same means, which succeeded so well, that in two months after the operation the patient was enabled to walk without crutches. Brainard opposes the use of the seton in these fractures, having found that threads of wool, cotton, and silk, when placed in contact with the bones of animals, produce inflammation and their absorption. Ollier's[3] experiments showed the same fact, but he found that, though the seton, if made to surround the bone of an animal, produced absorption in its track, it nevertheless excited the deposit of bone at a certain distance from its vicinity. He also, in experimenting upon fractures in rabbits, produced a large callus by the use of the seton, thus proving the different effects of irritation according to its degree—where intense, suppuration, and where in a weaker form, the formation of an abundant callus.

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[1] American Journ. of Med. Sciences for January, 1841, p. 141.

[2] Arzeneikundigen Annalen, by I. C. Tode. Kopenk, 1787, 1st part, p. 65.

[3] Thèse du Cal., 1854.

9th. *Setons near the extremities of the bone.*—Sometimes the seton cannot be passed between the fractured ends of the bone, in consequence of their being surrounded by a large cartilaginous or bony mass. In such cases, or where from other causes the seton as usually placed has failed, M. Oppenheim proposed, in 1828, and advocates the passing of two setons, not, as Dr. Physick advises, through the intermediate substance, but close to the bone near to the extremity of each fragment, and recommends that they should be permitted to remain no longer than is sufficient to establish free suppuration.[1] Two cases are given by him, one of the humerus, in a male æt. 30, and the other of the forearm, in a female æt. 44, in which this mode of practice was adopted with good results. In 1833, Saaurer also passed a seton around the tibia near the point of fracture. He made incisions down to the bone both internally and externally, and then pushed a seton-needle, half an inch broad and somewhat curved, through the internal wound. Considerable inflammation and suppuration followed, and the seton was removed on the tenth day; three months after the operation the patient was able to resume his field labors.[2] The same practice has been recommended by Mr. Gulliver, and Mr. Rhynd of Dublin. In either of the above methods, where the seton is slow in exciting a sufficient degree of action in the parts, it has been recommended to smear the cord with stimulating ointments, as the unguentum cantharidis, or the unguentum oxidi hydrargyri rubri, etc.

10th. *The passing of a ligature around the ligamentous mass connecting the fragments, and tightening it daily by means of a screw.*—This method has been adopted successfully by Seerig.[3] Longitudinal incisions, two inches in length, were made on each side of the fractured bone, and the fragments separated one from the other: a needle in the shape of the letter S, to which a ligature was attached, was then passed around the substance connecting the ends of the bone and the extremities attached to the serre-nœud of Græfe, which was tightened daily until the sixteenth day, when it dropped off.

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[1] Oppenheim, op. citat. p. 15.

[2] Oppenheim, op. citat. p. 15.

[3] Troschel de Pseudarthrosi, quoted from Arch. Gén. for Jan. 1839, p. 105.

11th. *The introduction of a wire between the fractured ends of the bone.*—This may be considered as another modification of Dr. Physick's method, and has been practised by Dr. Sommé, of Antwerp, in an ununited fracture of the femur of five months' duration. The wire was employed in preference to the silk seton of Dr. Physick, as M. Sommé judged the latter to act only on a small surface of the fragments, while by his method all the points of surface of the fragments would be irritated, and that successively, so that at no time could the irritation become dangerous. The operation is thus described: "The left femur was broken obliquely about the middle, and the fractured extremities rode over each other, the lower inwards, and the upper end outwards. The patient being placed on his back and supported, I passed a long trocar and canula, at first downwards on the inner side of the upper fragment, and made it pierce the skin behind, and a little to the outside; the trocar was then withdrawn, and a silver wire passed through the canula and out at the posterior opening. The canula was then withdrawn, and being replaced on the trocar, they were introduced again above and on the outside of the lower fragment, and made to pass out at the same opening behind. The trocar having been removed, the other end of the wire was passed through the canula so that both ends were in contact behind, leaving a loop in front. I then made an incision in front, from one orifice to the other made by the trocar, and drawing the extremities of the wire through the wound, brought the loop between the fractured ends of the bone, and approximated the edges of the skin with sticking plaster." The limb was kept at rest in a fracture box. At each dressing, the wire was drawn down, so as to depress the loop more and more into the flesh. No bad symptoms followed. Six weeks after the operation, which was done the

12th of August, 1828, the union was distinct, but the wire was not withdrawn till the 2d of October. The apparatus was continued to the limb until the middle of November. The patient is stated to have recovered without apparent shortening of the limb.[1]

12th. *Acupuncturation.*—Malgaigne, in 1837, attempted the cure of a disunited femur, in its lower third, by acupuncturation; but although mobile, the fragments were in such close contact, that of thirty-six needles introduced at different points, he could not succeed in passing a single one between the extremities of the bone.[2] The same practice has been followed by Lewis on the femur,[3] Wiesel on the forearm, and others, with success.

In 1845, Dieffenbach proposed a method for the cure of ununited fractures, by perforation of the ends of the bone, and the introduction of ivory pegs. His procedure is as follows: The limb being strongly extended, and the skin and soft parts made tense where the bones are most superficial, he passed down to them a long, narrow knife, about half an inch from each fractured extremity. Through this opening a small gimlet was introduced, and the bone carefully perforated, and into the perforations, ivory pegs slightly thinner than the gimlet, well oiled, were strongly wedged in. These were then covered by charpie, and splints applied to retain the limb in perfect quietude.[4] Several examples of success have been furnished by its originator.

Gurlt,[5] who has collected thirty cases which have been thus operated on, states that fifteen were cured, thirteen were failures, and in two the result was unknown. The late Dr. Brainard, of Chicago, urged the treatment by subcutaneous perforation of the bones, though he makes no pretension to have been its originator.[6] He thus speaks of it: "In case of an oblique fracture, or one with overlapping, the skin is pierced by an awl-shaped drill, at such a point as to be carried through the ends of the fragments, wound their surfaces, and transfix whatever tissue may be placed between them. After having penetrated the broken extremities in one direction, the drill is withdrawn from the bone, but not from the skin, its direction changed, and other perforations are made in the same manner. On removing the instrument, collodion is placed upon the points of puncture."

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[1] Med.-Chir. Trans., xvi. p. 36, 1830.

[2] Manuel de Méd. Opérat., p. 251, ed. iii.

[3] Mems. de la Soc. de Chirurg., vol. ii.

[4] Amer. Journ. Med. Sci., p. 478, vol. xiv. 1847.

[5] Handbuch der Lehre von den Knockenbrüchen, Hamm, 1862, p. 662.

[6] Transact. American Med. Associat., vol. vii. pp. 558, 84, 1854.

In a communication subsequently made to the *Chicago Medical Journal* for September, 1858, Dr. B. gives the result of his experience up to that time. "Of thirteen cases, four were of the humerus, four of the femur, three of the tibia, and two of the ulna. In the humerus, one was of four months' standing, aged 30. Two operations were done at an interval of ten days, and it was cured in one month. A second was of eight months' standing, aged 29. Four operations were done at intervals of ten days, and failed to effect a cure. Another, aged 24, had existed for six months. Five operations were performed at intervals of a week, and a cure took place in six weeks. The fourth was of five months' duration. He was treated for five weeks by six perforations without benefit. The seton and afterwards resection were then tried without producing union. Of the femur, the *first*, aged 35, was of five months' standing. It was treated by eleven perforations during five months, and cured. The *second*, aged 56, was of four months' standing, cured in six weeks after four operations. The *third*, also of four months, in a young man, was cured by four perforations. The *fourth* case, aged 36, was of five months' standing, and cured in four weeks by one operation.

In the tibia, one case was of four months' duration, in a man, cured in two weeks by one perforation; the second was cured in five weeks by four perforations; and the third, aged 21, of seven months' standing, was cured in four weeks by four perforations.

The first of those in the ulna was in a laborer, and had existed for three months. It was cured in twenty-two days by two perforations; and the second, a drunkard aged 35, of eighteen weeks' standing, was cured in four weeks by two perforations.

In none of the above cases did any serious accident occur. "In one," he observes, "a small abscess, and in another, a subject of bad constitution, some swelling resembling erysipelas, which, however, soon subsided. These were the most serious results of about sixty perforations." "My practice at present," he adds, "is to commence the treatment by two or three perforations of the bone through a simple opening of the skin, using an instrument of small size, and repeating this every ten days or two weeks, gradually increasing the size of the instrument and the extent of the wound of the bone, until tenderness and some swelling are induced. I have very uniformly found that, when pain and throbbing are felt in the seat of fracture, union has commenced." The procedure advised by Dr. Brainard is much the same as that imagined by Sir Charles Bell.[1] "In one case," says the latter writer, "I thought myself, by observations made on animals, authorized to propose that a sharp instrument should be pushed obliquely down upon the bone, so as to work upon and penetrate the extremities of the bones. By this means I imagined the wound made by the passage of the instrument would immediately heal, and yet the extremities of the bone be so excited as to resemble the state of simple fracture more than can possibly happen after cutting down upon them and sawing their ends." Sir Charles, however, never acted on the suggestion.

The ends of two or three acupuncture needles, after being passed into the ligamentous band of union, may be connected with the poles of a galvanic battery, and an electric current passed as an irritant. This proceeding is called electro-puncture. In 1848 Mr. Burnam employed galvanism as an exciting agent in an ununited fracture of the tibia of fourteen weeks' duration with success.[2] Dr. McRuer, of Bangor, Maine, resorted to it with a like result in an aged female, in whom the bones of the leg had not united at the end of eight weeks;[3]

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[1] Operative Surgery, 2d ed. 1814, p. 326.

[2] Lond. Med. Times, 1848.

[3] Trans. Amer. Med. Associat., vol. iii. p. 356, 1850.

and Dr. F. D. Lente furnishes three cases cured by this means, where it was applied three times a week. The needles, it is supposed, were passed to the periosteum on either side of the fracture.[1]

13th. *Scraping or rasping the fractured ends of the bone.*—This process was well known to the ancients. Avicenna describes it, and speaks of a philosopher who died from its effects. Guy de Chauliac notices this case mentioned by Avicenna but to condemn it and blame the philosopher, who, he says, "would have better merited this title by living with a halting gait, than by having the callus scraped and dying in great torments."[2] John Hunter irritated a false joint seated in the humerus with a spatula, after laying it open, with success; and Sir B. Brodie, on whose authority the statement is made,[3] thinks that "in all probability Dr. Physick borrowed his idea of irritating these joints by means of setons, from what had been done by Mr. Hunter." Mr. White, of Cherry Valley, New York, formerly President of the Medical Society of that State, also advised scraping of the extremities of the bone so as to remove their cartilaginous covering. The same practice is recommended by Van der Haar, of Holland. In 1814, M. Barthelemy proposed the use of a rasp, in form of a saw, and conveyed down to the fragments by means of a canula, to scrape the ends of the bone.[4]

The practice of scarifying the ends of the bones in ununited fractures, in order to induce the deposit of callus by the subcutaneous section, was proposed by Mr. Miller in 1844.[5] He passes a strong needle obliquely down to the part and moves its edge freely about in all directions, so as to cut up the ligamentous bond of union, as well as the dense investment of the ends of the bones; the needle being then withdrawn, and the puncture covered by plaster. By this means Mr. M. has cured an ununited fracture of the humerus, which had sustained compound injury about ten months before; the bones overlapped and could not be adjusted. On removing the splints, five weeks after the puncture, the parts were found quite firm. The same procedure has proved successful in two cases in the hands of Dr. Sanford of Davenport, Iowa, one of which had existed for three years, and the other for more than one year.[1] Mr. Hunter's method of irritating the ends of the bone is stated to have failed in two cases at St. George's Hospital, London.[2]

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[1] Trans. Amer. Med. Associat., vol. iv., 1851.

[2] Boyer, iii. p. 106.

[3] London Med. Gazette, xiii. p. 56, 1833.

[4] Vallet, quoted from Velpeau, ii. p. 588.

[5] Principles of Surgery, 2d ed. p. 692.

14th. *Hot iron.*—Heat applied between the fragments was successfully made use of by M. Mayor in 1828.[3] He thus describes its mode of application: "The canula of a large trocar was passed between the two oblique fragments of the femur, and left eight hours in place, through which a rounded iron was repeatedly passed, it having first been held in boiling water. By means of this burn at 100° R. I believed that I should be able to inflame the bony surfaces and surrounding tissues, and place them in a proper condition to unite." The case was one of seven months' duration, in which pressure and frictions had been uselessly tried.

15th. *Injections.*—The injection of stimulating substances has been adopted in cases of disunited fractures, accompanied by a wound or fistulous opening, by Dr. Hulse, of the U. S. Navy.[4] In the case reported by him, port wine and water, salt and water, and a solution of sulphate of copper were successfully employed, and a cure effected in two months. A solution of nitrate of silver, dilute alcohol, wine, and hot water, have also been proposed as injections into these joints. The rapidity with which a solution of iodine is absorbed, together with its well-tested stimulating effects as an injection in hydrocele, would induce me to give a preference to it over other stimulating articles. I am not aware of injections having ever been made use of in false joint unconnected with wound, and, though they might easily be introduced in such cases by means of a trocar, yet, judging from the severe effects sometimes known to follow the injection of stimulating fluid into the cellular tissue in cases of hydrocele, I should regard their employment as hazardous.

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[1] Trans. Amer. Med. Associat., vol. iii. p. 356, 1850.

[2] Works by Palmer, i. 505, 1835.

[3] Déligation Chirurgicale.

[4] American Journ. of the Med. Sciences, xiii. 1834.

16th. *Resection of the extremities of the bone.*—The method of treatment by resection was first brought into notice by Mr. White, of Manchester, in 1760. Petit, however, before this period removed with a trephine the ends of a fractured bone, affected with caries, and the operation is said to have been described as long ago as the time of Avicenna.[1] The case in which this practice was first tried by Mr. White,[2] was that of a boy, aged nine years, in whom a pseudarthrosis existed at the humerus of six months' standing. His injury had been a simple oblique fracture: the ends of the bone were found to be riding over each other, and the arm was not only useless, but a burden to him. Amputation was proposed for his relief, to which Mr. White objected, and suggested resection of the extremities of the bone and afterwards treating the case as a compound fracture. The patient did not lose above a spoonful of blood in the operation. In about six weeks after it, the callus began to form, and soon after became quite firm.

17th. *Resection of one of the fragments only*, has been practised in two instances by M. Dupuytren with success. This procedure, however, did not, as has been said, originate with him, since we find a case recorded by one of his own countrymen[3] in which resection of an inch of the inferior end of a non-consolidated fracture of the femur was made in 1758, with a view to procure union of the fragments. The same practice was pursued by Mr. Fisher at the Salisbury Infirmary in 1803. The patient, aged twelve, nine weeks previously had met with a compound fracture of the upper part of the femur. At this date, when first seen by his surgeon, no union had taken place. The wound was enlarged, and two splinters of bone, one of two and the other of three inches in length, were removed. The end of the inferior fragment, which was found very jagged, and riding over the superior portion, was then exposed, and three inches of it removed by a saw. The wound, which previous to the operation had presented an unhealthy appearance, was afterwards dressed with lint dipped in a decoction of bark, and rapidly healed. In less than two months consolidation was perfect, and the boy walking about on a crutch, his limb of course being considerably shortened.[1] White also, in a case situated in the tibia, and Inglis on the same bone, employed excision of the superior fragments only, with success, long before the time of Dupuytren. In the cases both of White and Dupuytren, it was the difficulty or impossibility of making the resection of the second fragment, which was the cause of limiting it to one.

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[1] Dictionnaire de Médecine, xiii. p. 503, 2d ed.

[2] Cases in Surgery.

[3] Mémoires de l'Acad. Roy. de Chirurgie, iv. p. 113, 8vo. Paris, 1819.

Mr. Jordan, of Manchester, in 1855, proposed a mode of treatment, which he calls periosteal autoplasty. It consists in separating carefully the periosteum from the portions of bones to be removed, by means of some blunt instrument, and then, after resection of both ends, replacing the separated periosteum in such a way as to cover over completely the ends of the bones with the raised membrane, and securing it by means of suture. Three cases are cited by him in which this procedure was employed; one in the leg, a child, and two in the humerus, the first of which was cured.[2]

Ollier suggested that in the sub-periosteal resection it is important to suture the resected portions of the bones themselves, but thinks no advantage is to be had from that of the periosteum, and Dr. H. J. Bigelow, of Boston, has put in practice and recommends this latter plan. His method consists in detaching carefully the periosteum from the extremities of the bone and the healthy shaft for at least a quarter of an inch on either side, taking care not to strip the bone higher than the line of proposed section or to detach it from the muscles, and then, after resection, boring each extremity "at a little more than half an inch from its end and through one wall only," and wiring the extremities. Dr. B. has adopted this practice in nine cases on the humerus, and one each of the femur and radius, and all with success except one on the arm, where amputation became necessary. In five of these cases, the seton, drilling, and excision, either with or without wiring, had been previously tried and failed.[1] After a detail of his cases, Dr. Bigelow remarks, "through not a trivial operation, it is not dangerous." This conclusion, despite his own remarkable success, is not justified. General experience, as will be shown hereafter in this paper, proves, that resections are dangerous and often fatal. That it is not lightly to be undertaken is well shown by one of his cases (V.) where "the ends of the bone were turned out with great difficulty," and "the operation occupied about two hours." In Mr. Jordan's reflections upon his cases, he observes, the method is "not exempt from danger," and thinks no prudent surgeon will resort to any resection without having first tried more simple means.

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[1] Lond. Med. and Phy. Journ., vol. ii. p. 37, 1804.

[2] Traitement des Pseudarthroses par l'Autoplastie Périostique. Paris, 1860.

18th. *Excising the ends of the bone, and afterwards engaging the point of one of the fragments in the medullary canal of the other*, so as to maintain the extremities in contact, has been done by M. Roux.[2] No accident followed the operation, but it is stated that at the end of two months a fall upon the fractured arm prevented any benefit from the treatment, and necessitated the amputation of the limb.

19th. *Exposing the ends of the bone and rubbing them over with caustic.*—The proposal to apply caustics to the fractured extremities originated with Mr. White, of Manchester. The case in which he adopted it was an ununited fracture of the leg of nine months' standing, and in it the extremities of the bone were sawn off, and, about a week after, the ends were touched with the butter of antimony. A slight exfoliation occurred, and the patient recovered with a firm limb. Mr. Henry Cline, of London, in 1815, was, I believe, the first who made use of caustic, without having recourse to previous removal of the ends of the bone. His case was successful. Mr. Earle, in 1821, made use of it in two instances,[3] though without success: one of these was in a case of ten months' duration in which the seton had previously failed. After the application of the caustic, callus was deposited, and the limb became much stronger, but this was afterwards absorbed. The fracture in his second case (produced by the lifting of a teapot), was of nine years' standing, and occurred in a patient "worn out with mercury," in whom nearly every cylindrical bone in the body was diseased: a case evidently unfitted for any operation. In 1827, Dr. Hewson applied the caustic potash to an old fracture of the leg, after removal of the ligamentous matter connecting the fragments, with the happiest effect.[1] At the end of eight weeks cicatrization of the wound had taken place, and after twelve weeks the fragments were firmly consolidated. Another ununited fracture of the tibia, successfully treated by the butter of antimony, has been reported by Lehmann.[2] The caustic in his case was applied after removal of the matter separating the ends of the bone; four weeks afterwards some small pieces of bone were discharged, and in a short time the patient was able to make use of his limb. The same caustic has been used with good effect in an instance reported by Weilinger.[3] Ollenroth touched the fractured extremities with fuming nitric acid, and was successful.[4] The caustic potash has been successfully used in three or four cases by the late Dr. J. R. Barton, of this city, in one of which (following a compound fracture of the leg of 16 or 18 months' standing) Dr. Physick discouraged the employment of the seton from fear of its failure. I have myself, in a case of want of union in the humerus of four years' duration, employed the potash with the most perfect success.[5]

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[1] Ununited Fracture successfully treated, with Remarks. Boston, 1867.

[2] Bérard, Thèse, p. 53.

[3] Med. Chir. Trans., xii. 1822.

20th. *Actual cautery.*—Petit describes the case of a youth affected with ulcer and caries of the tibia at its middle, which became the seat of fracture, the fibula remaining whole, in which he cauterized the extremities of the bone, and afterwards took off the carious parts with a trepan; having done this, he applied lint to the naked bone, well saturated with tinct. aloes: at the end of fifty days the diseased bone separated from the sound portion, after which union occurred.[1]

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[1] North American Med. and Surg. Journ. for January, 1828, p. 11.

[2] Graefe & Walther, iii. 2e cah. 1822, quoted from Bérard.

[3] Oppenheim, op. citat., p. 8.

[4] Oppenheim, op. citat., p. 7.

[5] Norris, Surgical Report of Pennsylvania Hospital, Am. Journ. of Med. Sci., vol. xxxiii. 1838.

21st. *Removing the extremities of the bone and connecting the fragments by means of wire.*—The tying together of the fragments in recent fractures of the lower jaw, where there is a difficulty of retaining the ends in contact, by means of a silver or other wire passed around the teeth, has been recommended since the days of Hippocrates. In 1818, M. Dupuytren practised this method upon a case of an ununited fracture of the lower jaw, which had existed nearly three years.[2] In this instance, he resected the posterior fragment, rasped the anterior, and secured the fragments in close apposition by means of a platina wire passed around the teeth. The application of this procedure to fractures of long standing, however, did not originate with him; the same practice having been pursued in 1805 by M. Horeau in a similar case.[3] The idea of securing the long bones in close contact by connecting them with wires, in cases of recent compound fractures, was also proposed and practised before the time of Horeau, by a surgeon named Icart. His method was to surround and draw closely together the fragments by means of a metallic ligature, for the purpose of preventing displacement; and states that he has seen it put in execution with success.[4] The practice, however, was strongly reprobated by his brother practitioners, particularly by Pujol, in the journal above quoted, as well as in a memoir upon the subject published about the same period. For an ununited fracture of the patella it was proposed, as far back as the time of M. A. Severinus, to freshen the ends of the bone, and afterwards tie them tightly one against the other,[5] and a late well-known surgeon of a sister city,

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[1] Quoted from Heister's Surgery, ed. 1743, p. 114.

[2] Leçons Orales, iv. p. 669.

[3] Journ. de Méd. Chir. and Pharm. in 40 vols., x. p. 195, 1805.

[4] Journ. de Méd. Chirurg. and Pharm. par M. A. Roux, xlv. p. 167, 1776.

[5] Velpeau, op. citat., ii. p. 591.

Dr. J. Kearney Rodgers, has recently revived this practice,[1] and has in several instances drilled holes through the extremities of the bone, and then brought them together by means of silver wire. The object of the wire is to bring the fractured fragments in contact, and so retain them. We cannot conceive it possible that it should ever be found a difficult matter to bring the fractured fragments in apposition after resection of their ends. The loss of bone has been, in those instances we have witnessed, and must, we judge, always be, sufficient to allow of their being so placed by position and a proper apparatus alone. The drilling of holes, and fixing of wires to the bones, besides lengthening an operation which is always tedious and painful, must necessarily expose them to denudation of the periosteum, and consequent caries or necrosis. We have never had an opportunity of witnessing this operation, but all theoretical reasoning would lead us to condemn it. One instance has come to our knowledge in which the operation of Severinus (on the patella) was put in execution, and a fatal result followed on the fourth day. Malgaigne, writing in 1840, erroneously gives the credit of this mode of operating to M. Flaubert of Rouen, who, he says, had performed it on the humerus a short time previously with a satisfactory result.[2]

22d. *Amputation.*—In ununited fractures, as in all other cases coming under the care of the surgeon, amputation is his last resource; it should never be resorted to in pseudarthrosis, except after the failure of every other means, and then only when it renders the life of the patient miserable, and he himself demands it. A few surgeons would have us reject all operative measures for the cure of ununited fractures. Among these is Larrey, who advises if union has not been effected during the first period of treating a fracture that "the case should be abandoned to nature." My late friend, Dr. John Watson, of New York, entertained nearly similar views, for, after having been an attentive observer of the cases of fracture at the hospital of that city for many years, and witnessed various modes of treatment instituted for the cure of false joints, he avers, "that he has yet to see the case in which he would employ either seton, excision, caustic, perforating plug, or the wire ligature."[1] Where in the judgment of the surgeon it is not thought proper to resort to any of the means of treatment which have been considered, or where these may altogether or in part have failed, various machines have been devised to palliate the condition of the patient, and render the limb in some degree useful. Allusion has already been made to those employed by White, Inglis, Kuhnholtz, Troschel, Smith, and others, and a reference to the cases of these gentlemen will give ample information in regard to this subject. With these instruments, as with all the rest of the armamentarium of the surgeon, the simplest will be found the most effectual, and will at the same time be worn with the most comfort and convenience.

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[1] New York Journ. of Med. and Surg., i. p. 343, 1839—paper by Heard.

[2] Op. citat. p. 249, 3d ed.

Before closing this part of our subject, a recommendation promulgated by a surgeon who has devoted much time to an experimental essay upon the causes and treatment of ununited fractures, merits notice, inasmuch as the practice, in the opinion of the writer of this paper, may lead to injury. Dr. Brainard, in his Essay,[2] after showing the results which followed the operation advocated by him for the cure of ununited fractures, viz., perforation of the ends of the fragments, says: "The application of the perforator is so little painful, and so effectual, that I would recommend its employment where union is at all delayed for the purpose of preventing a false articulation from being formed, as well as for curing it where it has already occurred;" and again, "If there is not decided commencement of union at the end of six weeks, perforations should be made with a small instrument," and appends in illustration some cases treated in this manner which were "not of long standing, and might have eventually united without any operation." The instances adduced to support this recommendation all did well, but we have no right to assume, nor, as shown by the quotation just made, does the author himself do so, that such would not have been the result without artificial aid of any sort. We know, however, that fever, erysipelas, and abscess not unfrequently arise from an operation as simple as that of acupuncturation, and experience teaches that these states may give rise to an absorption instead of a deposit of callus, and that a prolonged treatment, suffering, and complete want of union may follow as a consequence. My own observation, after a long hospital experience in fractures, leads me to recommend, when motion is still found to exist at the period usual for these accidents to become consolidated—that is, in cases of simply delayed union, that the treatment by perfect rest and pressure should be continued, and if possible more carefully attended to than before, for, as a general rule, cases in which there is this delay in consolidation are not to be despaired of even after the lapse of five or six months. Constitutional treatment should at the same time be carefully employed, every means being taken to invigorate the patient, and to place his general health in a good condition. If, after the lapse of the time mentioned, firm union still fails to occur, the case should on no account be abandoned by the practitioner, but frictions, irritants, and electricity should be used, and not until these have been first fairly tried should resort to operative means be recommended, and even then I would long hesitate in urging them, in cases which incommode the patient but slightly, or which can be efficiently remedied by artificial support; but under opposite circumstances, severe and dangerous as the mildest of them must be acknowledged at times to be, sound surgery and experience justify their use.

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[1] New York Med. Times, p. 12, 1851.

[2] Transact. of the Amer. Med. Associat., vol. vii. p. 586, Philada. 1854.

The few pages devoted to the consideration of non-con-consolidated fractures in our treatises on surgery, are for the most part extremely vague and unsatisfactory; and in practice the various modes of treatment recommended for their cure are resorted to without discrimination, according to the particular fancy of the surgeon. The methods that we have enumerated have all at different times been much vaunted by practitioners, and, as might be expected, have all in some instances been followed by failure. One of the British writers, who appears to have devoted most attention to the subject of these affections, is of opinion that all modes of treatment have been very unsuccessful; so much so, that he thinks he is far within the mark in stating, that not one in twenty in which they are tried is followed by a favorable result. This statement is based upon recollection alone; though not very unfrequent, the failures are believed not to be so numerous as is here stated. Our tables show, that out of 150 published cases, 113 have been cured. In their treatment no exclusive method should be adopted; all may at times be applicable, and may be regarded as good or bad, according to the particular condition of the parts in each individual case. In making choice of a plan of treatment, we should be governed by the situation of the injury—whether near a joint or otherwise—the limb affected—the length of time which the fracture has existed—the degree of mobility existing in the fragments—whether the fragments be in apposition or otherwise—whether connected by a ligamentous band, or united by means of a preternatural capsule, should be carefully ascertained before the kind of operation to be employed is decided upon. The five following classes will embrace all the modes of cure most commonly resorted to; and the particular cases to which these are applicable, together with the main objections which at different times have been urged against them, we shall now briefly enumerate.

1. Compression and rest. 2. Frictions. 3. Seton. 4. The application of caustic to the seat of fracture. 5. Resection of the ends of the bones.

1. *Compression and rest.*—Commonly speaking, the terms ununited, or disunited, when applied to fractures, are used simply to express that the bones bend and have not become firm at the injured part, without reference to the length of time that has elapsed since the occurrence of the accident, or the state of the fragments which exist; and many cases are reported which were cured by continuing the application of the apparatus employed, without requiring any further assis-

tance from the surgeon. Properly speaking, the union in these cases is simply delayed; and it is to these delayed consolidations that the treatment by rest and compression is peculiarly applicable. Besides these, compression and rest are always adapted to, and will be likely to prove successful in, cases of non-union in which the cause can be attributed to motion, or want of proper position after the recent fracture, where the ends of the bones are not absorbed and are connected by fibro-cartilaginous substance, into which sufficient bone has not been deposited, or to cases where no sort of union has taken place in consequence of previous want of perfect apposition, provided the ends can be brought into contact and the fracture has existed but a few months. To cases, also, which are accompanied by an inflammatory state of the fragments of the fractured limb, this treatment is well suited. In all of the first-mentioned order, it must be evident that the chances of union become probable when the broken bones are brought into contact and so retained; and in the latter, consolidation will be apt to occur upon the subsidence of the increased action in the limb, consequent upon its being placed in a state of perfect quietude. As the method is unattended with danger, it should always be resorted to in instances of the kind mentioned, particularly when in young subjects, previous to performing any of the more serious operations which have been proposed for remedying this accident. In cases where there exists an approach to a capsular ligament, or where the ends of the bone are diseased, or are prevented from uniting by the interposition of a foreign substance, or are rounded and separated, though connected by means of ligamentous matter, the mere influence of pressure and rest is not alone sufficient to produce a cure. Where pressure directly over the seat of fracture is made use of, the tourniquet is preferable to the roller, as by means of the screw a more equable degree of pressure can be kept up, and, if pain or other unpleasant symptom follow its application, can be loosened without putting the surgeon to inconvenience. Pressure and a state of perfect repose have been sometimes produced by the immovable apparatus, which, if ever to be approved, is in the class of injuries that we are now treating of.

Out of 36 cases included in our table, treated by pressure and rest, 29 were cured. Of these,

13	were in the	femur,	of which	9	were cured.
7	"	leg,	"	7	"
12	"	humerus,	"	9	"
4	"	forearm,	"	4	"

The longest period that the fracture had existed in these cases was 22 months (femur, æt. 27). The shortest period was 4 weeks (forearm, æt. 12). The average period was 5 months and 12 days. The longest period required for a cure was 5 months (humerus, æt. 24). The shortest period was 18 days (femur, æt. 25). The average period was 9 weeks.

In the 36 cases in which pressure and rest were employed, accidents depended upon the treatment, and, not terminating in death, are stated to have occurred four times—(excoriations 1, severe pain and inflammation 3).

2. *Frictions.*—In making use of frictions, the object aimed at is to break up any ligamentous bands that may unite the fragments of the bone, and by rubbing these together destroy any covering which they may have, and produce a degree of irritation as great as would follow a recent fracture. Boyer denounces the use of frictions, believing that if deposition of callus has commenced, rest alone will be sufficient for the cure, and, if a false joint is already established, the frictions will be totally without benefit, and will, besides, expose the patient to serious accidents from the contusion and tearing of the surrounding soft parts.[1] Before the time of Boyer, Duverney had pronounced this method to be only good in the study, "for, however the whole end of the cemented bone be rubbed, it is useless and even dangerous to the patient."[2] Kluge permits his patients to use a limb if it still remains flexible after the lapse of time usually occupied in consolidation, and, when inflammation is thus excited, he restores it to its previous

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[1] Op. citat., iii. p. 106.

[2] Diseases of the Bones, transl. by Ingham, p. 176.

quiescent state.[1] In every instance a quick and firm consolidation resulted. A good example of the benefit to be derived from frictions produced by allowing the patient to move about upon his limb is given by Mr. Home.[2]

Experience proves that where there is simply tardiness in the formation of callus, the method by friction, though it has often failed, may be serviceable; and, as, with the exception of the case reported by White, in which abscess followed, we are not aware of any instance ever having been reported in which unpleasant symptoms were produced by it, would advise a trial being made with it after compression has failed, before resort is had to any more severe measure. Frictions, however, in such a degree as to risk serious injury to the surrounding parts, are unwarrantable, nor should they ever be employed where any degree of union has commenced, until it is well ascertained that nature unassisted is incompetent to produce firm union, as we know that motion will sometimes cause rapid absorption of the matter effused between the ends of the bone. On this account the practice advised by some surgeons, where union is tardy, of removing all apparatus and allowing the patient to move his limb freely while in bed, is to be deprecated as being doubtful in its results.

The treatment by frictions is particularly applicable to the cases described in our second order, where the fracture has been nearly transverse and union of no sort exists between the fragments. In most instances of our third order, the fibro-ligamentous connections between the fragments is so strong as to prevent a fair trial of this means; but such cases would probably all be cured by rest and compression. Of the two methods of making use of frictions, preference should, we think, be given to that of seizing the extremities of the bone and rubbing their ends together, as by it frictions are more effectual, and the liability to danger less imminent, than in binding up the limb and suffering the patient to move about upon it. Where, however, the degree of motion is slight, the latter mode may be advantageously employed. The necessity of a state of perfect rest, after a sufficient degree of irritation has been once set up, has been already stated, and is highly important.

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[1] Oppenheim, op. citat., p. 4.

[2] Trans. Soc. for Improve. of Med. and Chir. Knowledge, vol. i. 1793.

In addition to the cases cited in the accompanying tables in which frictions have been used, the method has been employed successfully by Briot;[1] by Champion,[2] in a leg after two and a half months; Jacquier d'Ervy,[3] in a leg; Vogel,[4] in a clavicle; Basedow,[5] in a leg after five weeks; Steinheim,[6] in a femur; Sanson,[7] in a femur of more than a year's duration; by Ashmead (communicated to author), in two cases in the leg after the lapse of several months; and by Kirkbride, in a humerus that had failed to unite at the end of three months.[8] Bonn, Germain, Hain, Ansiaux, and others have, however, failed.

3. *Seton.*—From its first proposal by Dr. Physick, the use of the seton has received continued opposition, both in England and France. By authoritative writers of these countries, it is stated most generally to have failed in producing union. Mr. Amesbury, writing in 1829, thus expresses himself in regard to it: "I have seen three cases of non-union treated with setons—one in the femur and two in the humerus. The constitutional disturbance produced by the seton in the thigh was extremely severe: but the irritative fever occasioned by it in the other two instances was not great. Not the least benefit was obtained from its employment in either case." He adds, "Though I have heard of many cases of non-union treated by the employment of setons, I am not aware that there are more than three treated in this country, where its operation appears to have brought about consolidation of the bone."[9] Another high authority, Mr. Lawrence, remarks:[10] "I believe it may be said that there are some two or three instances recorded, in

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[1] Malgaigne, p. 248.

[2] Velpeau, op. citat., ii. p. 783.

[3] Idem.

[4] Idem.

[5] Bérard, op. citat., p. 44.

[6] Oppenheim, op. citat., p. 5.

[7] Dict. de Méd. and Chir. Prat., iii. p. 500.

[8] Am. Journ. of the Med. Sci., xv. 1835.

[9] Op. citat., p. 224.

[10] Lond. Med. Gazette, vi. p. 355, 1830.

which, after some weeks or months of confinement, with a good deal of pain and danger, the union has been effected in this way; but in other cases the introduction of the seton has failed." Speaking of the seton in his lectures, in 1833, Brodie mentions his having used it in three cases. The first was in an ununited fracture of the femur, and union took place though it was not completed until after a long period of time. The second case, also of the femur, was followed by so much disturbance of the constitution, that he became alarmed, and the seton was removed. The symptoms after this subsided, and it was re-introduced and kept in for a length of time, but no cure was effected, and the patient left the hospital with the bones as loose as when he was first admitted. In the third case the injury was in the clavicle, and was of many years' standing, and here a perfect cure was accomplished after the use of the seton for several weeks. He then adds, "The result of the practice in England appears to be, that sometimes it has succeeded in the upper extremities, but that where it has been performed on the lower extremities, as far as I know, it has only succeeded in a single instance, viz., that of the patient under my care."[1] Mr. Palmer,[2] writing in 1835, speaks of its having succeeded "in a *few* cases." Syme thinks the irritation determined by the presence of a seton cannot be useful but when there is a commencement of union.[3] M. Sanson summarily condemns the treatment with the seton, and advises its rejection.[4] Larrey says he would never recommend the seton or resection, in these cases;[5] and M. Velpeau[6] describes it as a very uncertain method of treatment, and gives a preference to the operation of resection, if frictions, or the immovable apparatus, are not sufficient for the cure. The opinions expressed by the above quoted gentlemen show the estimation in which the method is held by many in Europe. Most erroneous notions of the estimation in which the seton continued to be held after an experience of many years, by its discoverer, as well as of the opinions entertained of it by the great mass of surgeons in this country, are at this time circulated abroad. In some editorial remarks of one of the French journals,[1] it is gravely asserted that in the United States so little benefit has been derived from the employment of the seton in false joints, that it is now no longer employed there—Dr. Physick himself having renounced the treatment during the latter years of his life. We have authority for stating that up to the period of his death, Dr. Physick always advocated the treatment of these cases by the seton, and may safely assert, that results in America have proved it one of the safest, least painful, and most effectual, of the numerous operations that are performed for the cure of pseudarthrosis.

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[1] Lond. Med. Gazette, xiii. [2] Edit. of Hunter, i. p. 505, 1835, note.

[3] Edin. Med. and Surg. Journ., July, 1835.

[4] Dict. de Méd. and Chir. Prat., iii. p. 504.

[5] Clin. Chirurg., iii. p. 460. [6] Op. citat., ii. p. 587.

The following instance, taken from the Case Book of the Pennsylvania Hospital,[2] is interesting, as showing that Dr. Physick was not prevented from resorting to the seton even after an accident had occurred on a first attempt at placing it. On the 20th November, 1807, Bryan Malone, aged thirty, received a fracture of the right leg, a little below its middle, and also a fracture of the thigh of the opposite side. The thigh united in the usual time, while in the leg the fibula united but the tibia remained loose. At the end of a year a seton was introduced between the ununited fragments and a large bloodvessel wounded. Hemorrhage was with difficulty restrained by firm compression, elevation, cold, etc. The seton was withdrawn during the treatment for the bleeding, and no union had taken place after the ulcers resulting from the wound had healed. In March, 1809, the patient entered the hospital, and on the 24th of that month, Dr. Physick passed a seton; some fever and pain followed it. On the 18th of June the fracture was firmly united and the seton was removed, and he left the hospital on the 29th. Another instance in which a second seton was used successfully, after a previous attempt by this mode of treatment had failed, is given by Roux.[3]

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[1] Gazette des Hôpitaux, No. xlix. p. 196, 1839.

[2] Vol. i. p. 88.

[3] Gaz. Méd., No. 26, p. 407, 1842.

Much difference of opinion prevails, not only as to the mode of applying the seton, but also as to the length of time which it is necessary to allow it to remain in place. Dr. Physick recommends it to be passed through the integuments and between the ends of the bone, by means of a long seton needle armed with a silk ribbon, or French tape, without previously cutting down to the bone, and advised that it should be left in place for four or five months, or longer.[1] Other practitioners, however, have preferred that the soft parts should be first divided, so as to expose the seat of the fracture, and that it should be removed at the end of a week or two. The first method of operating, as being less painful, and attended with less danger, should, we think, be preferred. The length of time the seton should be allowed to remain, it is impossible to fix upon, but, as the object of it is to excite action in the bone and parts around, and not to promote suppuration, which we know in compound fractures often prevents the union, it would seem that it should be removed without regard to time, as soon as a considerable degree of action is excited, and before excessive suppuration is established. After its withdrawal the limb should be splinted with great attention, and every possible care taken, to keep it in a state of perfect quietude. The seton is especially suited to those cases of preternatural joints which occur in the upper extremities, inferior maxilla, and clavicle, where the fragments can be placed in apposition. In the femur it has often failed; Dr. Physick has tried it in three cases of artificial joint in this bone, without satisfactory results. The experience of Sir B. Brodie, as we have seen, is to the same effect. The cause of failure in these cases is probably owing to its inadequacy in the larger bones to excite a degree of inflammation sufficient to give rise to ossific action. One of the cases in which the seton failed in the hands of Dr. Physick, was that of an adult male who was admitted into the Pennsylvania Hospital, Feb. 17th, 1810, with an artificial joint of the femur following an oblique fracture of the bone just below the trochanter major. His accident had happened eight months previously. On the 28th an incision down to the bone was made over the seat of the fracture, and a seton introduced. On the 4th day, fever and retention of urine followed, but soon disappeared. On the 20th of April an extensive abscess formed in the thigh, and his health had become in some degree impaired. On the fourth of July, on account of the fever, diarrhœa, and debility of the patient, the seton was removed, having been allowed to remain four months and four days, without producing any bony union.[1] I have myself witnessed in our hospital two cases in the femur where the seton was tried without benefit. The first of these was in a woman, aged 33, who was admitted in February, 1848. The accident had happened eight months before admission by being thrown from a swing, and the upper end of the bone had protruded slightly, but the wound healed kindly. The injury was near the middle of the bone and no trace of union could be detected. Pressure and rest had been used before her reception, and were again tried for three months after her admission, without benefit. A seton was then introduced on the 24th of June with no beneficial result, and in October it was removed, and soon afterwards I amputated the thigh at her urgent request. In the second case, that of a laborer, aged 23, the injury was of nine months' standing, and three weeks after its insertion by Dr. Peace the patient died of pyæmia.

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[1] Hays, in Am. Journ. Med. Sci., Nov. 1830, p. 271.

The situation of the fragments—their being widely separated, or placed in such a direction that they cannot be readily kept in contact; or the abundant deposit of callus about their extremities, may be obstacles, sometimes insurmountable, to its use. The existence of great malposition in the fragments will generally preclude its employment. Close proximity of the fracture to the main artery and nerve, or to an important joint, may also at times prevent a trial with the seton. Where the bone has been for years disunited, and the fracture is very loose, or presents irregular surfaces, the seton is entirely unsuited. In all other cases, it should be preferred to all other operative procedures, as in case of a failure with it some of the more serious operations may always be resorted to. Weinhold[1] imagines that the principal cause of failure with the seton (as used in Europe in connection with an external incision) is, its permitting the access of the external air to the extremities of the bone, which, for that reason, are extremely disposed to become carious; and to obviate this he proposes making the wound funnel-shaped, and using a conical or wedge-like seton. In addition to the cases treated by the seton which have been already alluded to, or are included in our tables, this method of treatment has been successfully used in the forearm by Delpech,[2] in the leg by Rigal de Gaillac, in the clavicle by Randolph, and by Saurer in the leg in a case of eight months' duration.[3] Of three ununited fractures of the humerus in which the seton was used by Mr. Crompton,[4] two were successful after extensive suppuration, and in the third, the needle could not be passed between the ends of the bone, and, as there was a good deal of strength in the member, the patient was advised to allow it to remain as it was. In three cases situated in the tibia, treated by the same surgeon, all were much benefited by the seton, combined with pressure and rest, and he believes they all got well finally. A fourth instance which he saw in the tibia, where the fractured extremity became loose during a severe attack of pleurisy, was also caused by the same means. In the case of a non-united fracture of the humerus, cited by Lombard,[5] it was employed without benefit, and on the same bone with only partial success, by Béclard of Strasburg. In another case on the humerus treated at the Richmond Hospital with the seton by Mr. Carmichael, its introduction was followed by a severe attack of erysipelas and very nearly caused the death of the patient.[6] An ununited fracture of the acromion process of the scapula, occurring in a female, which was treated by the seton some years back at the almshouse infirmary of this city, terminated in death. Professor Mott's experience in the use of the seton has been large; eleven cases have been treated by this method by him, of which three were of the femur, three of the tibia, and five of the humerus. In all it succeeded perfectly except in three of the last-mentioned bone, which were afterwards cured by resection of the ends.[1]

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[1] Penn. Hosp. Case Book, i. p. 108.

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[1] Med. Recorder, xiii.

[2] Clin. Chir., i. p. 255.

[3] Oppenheim, op. citat., p. 15.

[4] Lond. Med. Gaz., vol. ii., N. S., 1850.

[5] Velpeau, op. citat., ii. p. 586.

[6] Cyclopædia of Pract. Surg., p. 91, 1842.

Reference to the tables appended to this paper exhibits the following results in 46 cases in which the seton and its modifications were employed. Of these,—

13	were in the	femur,	of which	9	were cured.
10	"	leg,	"	10	"
16	"	humerus,	"	10	"
6	"	forearm,	"	6	"
1	"	jaw,	"	1	"

Of these 46 cases, 21 are stated to have had an incision made down to the bone previous to the introduction of the seton, and 24 had it passed without a previous incision. Of the 21 where previous incision was made, 17 were cured, 2 improved, 1 failed, and 1 died. Of the 24 in which there was no previous division of the soft parts, 18 were cured, 1 amended, 4 failed, and one died.

In one case the seton was passed through a fistulous opening which previously existed.

The longest period that the fracture had existed in these cases was 10 years (femur, æt. 26). The shortest period was six weeks (tibia, æt. 48). The average period was 12 months and 12 days.

The longest period that the seton was allowed to remain was 13 months (humerus, æt. 48, failed). The shortest period was 7 days (forearm, cure). The average period was 7 weeks and 3 days.

The longest period required for the cure was 8 months (femur, æt. 41). The shortest period was 3 weeks (humerus, æt. 23). The average period was 2 months and 24 days. In 17 of the cases in which the seton was employed, other methods of operating are stated to have been tried and to have failed.

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[1] Vaché, in Am. Journ. of the Med. Sci., ix. p. 262.

In the 46 cases treated by the seton, accidents dependent upon the method employed, and not terminating in death, are noted as having occurred 12 times (arterial hemorrhage twice; severe fever, erysipelas, or profuse suppuration, ten times).

4. *The application of caustic to the seat of fracture.*—The application of caustic to the ends of the fractured bone after free exposure of them is a more powerful means of effecting the requisite irritation in the periosteum and bone than the seton, and seems worthy of more extensive employment than it has heretofore received. From the ease with which the operation can be done, the little pain attendant on it, and the almost certainty of producing by it a degree of action in the parts sufficient to excite a deposit of callus, without at the same time keeping up that action so long as to cause excessive suppuration, which often leads to failure, I am induced to prefer it to excision of the ends of the bone, and would recommend it in those cases which are rebellious to the simpler modes of treatment, viz., compression, frictions, and the seton. In performing the operation, the seat of fracture is to be fairly exposed, the substance connecting the ends of the bone divided, and the wound carefully dried; after which the caustic is to be rubbed over them. The wound should then be filled with lint, and the limb placed in a state of the most absolute rest.

The operation with the caustic is as applicable to the lower as the upper extremity, and is the only procedure, except resection, that is well suited to cases which have been for years disunited, or are very movable, and surrounded by a preternatural capsule.

Different caustics have been made use of in these cases. White and Lehman employed the butter of antimony. Ollenroth has proposed the nitric acid. In the cases reported by Cline, Earle, Barton, and myself, the caustic potash was used, and is, I think, preferable.

5. *Resection of the ends of the bone.*—This method of treatment, though it has been frequently adopted with success, is nevertheless attended with great danger. All writers who

have practised it acknowledge its severity, and few recommend its employment except in extreme cases. Mr. Lawrence thus notices resection: "This is a serious proceeding; indeed, in the middle of a fleshy limb, as the thigh for example, it must be a very difficult thing to accomplish."[1] Boyer describes it as one of the most serious operations in surgery, and speaks of it as "painful, bloody, and of uncertain success."[2] Barton views it as difficult for the surgeon, besides being painful, and of doubtful result both to the limb and life of the patient.[3] Liston regards it as a "difficult and severe process;"[4] and states that he has never attempted the operation but once, and then failed in procuring union. Sommé mentions an instance of ununited fracture of the arm, in which he witnessed the operation of amputation of the fractured extremities without any benefit resulting, and pronounces the method "barbarous," and thinks "it ought to be rejected from surgical practice."[5] Gouraud looks upon it as a retrograde step in surgery.[6] Mr. Rynd,[7] speaking of sawing off the ends of the bone in these cases, says: "I suppose no surgeon of the present day would seriously entertain it." A recent continental writer[8] well remarks, that "in pseudarthrosis of the thigh the question may seriously be asked if we should not prefer amputation at the point of the false joint to any other dangerous or doubtful operation. This question only the peculiarity of the individual case can decide. In some cases the safe aid of a suitable splint apparatus is preferable to any operation," and M. Velpeau, though an advocate for this mode of treatment, candidly exposes its great dangers. We should never, says he, "decide upon this operation without having well considered it. Requiring a deep and large incision into the soft parts, it places the bone in the state of a recent fracture accompained with severe wound, from whence results the danger of excessive suppuration, erysipelas, caries, necrosis, as well as of purulent absorptions, and phlebitis."[1] Jourdan thinks that resection is only practicable on the humerus, or at furthest on the femur, and that the accidents which terminate almost always in death should make us prefer amputation.[2] Mr. Rowlands, after reporting a case in the femur successfully operated on by resection of the ends, states, that the operation far surpassed in severity "anything I had ever undertaken or witnessed, and I am doubtful as to the propriety of recommending it to others."[3] On the femur this operation is particularly severe, and the great length of time required for its performance on that bone is alone, in debilitated patients, a sufficiently strong objection to it. In a case of resection of the thigh-bone noticed by M. Vallet,[4] the operation is stated to have been of extreme severity, and to have lasted more than an hour: the patient, who was young and vigorous, had convulsions, and died the same evening. In the case of Walb, reported by Dr. Kirkbride,[5] the operation lasted near two hours, the patient afterwards dying of pyæmia on the sixteenth day. And in a patient that I saw operated upon at the Pennsylvania Hospital in 1833, the operation was tedious and painful, though, after a long confinement and exposure to great dangers, he was finally cured. In one of the cases reported by Dr. Bigelow on the femur, the operation of resection and drilling "occupied about two hours," and "the ends of the bone were turned out with great difficulty." Speaking of the treatment of ununited fracture by excising the ends of the bone, Mr. Crosse observes, that he has known excision cure; "but it so often fails as to render the practice very discouraging,"[6] and M. Sanson thinks that "all prudent practitioners will agree that it is better to leave the patient with his infirmity, which in no way endangers life, than seek to remove it by an operation which greatly perils it."[7]

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[1] Lond. Med. Gaz., vi. 1838.

[2] Maladies Chirurgicales, iii.

[3] Med. Rec., ix. p. 276, 1826.

[4] Lancet, ii. 1835–6, p. 169.

[5] Med. Chir. Trans., xvi. p. 39.

[6] Méd. Op. Velpeau, ii. p. 589, Paris, 1839.

[7] Dublin Quart. Med. Journ., vol. iv. 1847.

[8] Billroth, trans. by Hackley, 1871, p. 210.

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[1] Idem., ii. p. 592.

[2] Dict. des Sc. Méd., art. Fausse Articulation.

[3] Med. Chir. Trans., ii. p. 49.

[4] Méd. Op. Velpeau, ii. p. 589.

[5] Am. Journ. Med. Sci., xvii. p. 46.

[6] Retrospective Address, p. 80.

[7] Dict. de Méd. and Chirurg. Prat., iii. p. 505.

The mode of treatment by resection is more particularly applicable to such fractures as are accompanied with great deformity, or have been for a very long period disunited, and have the ends of the bone very widely separated and loose, or such as are surrounded by a preternatural capsular ligament, with the fractured ends enlarged, than to those cases in which the ends of the bone are connected together by a ligamentous band only. It is better adapted to parts in which but a single bone exists, as the humerus and femur, than to the forearm or leg. As with the seton and other methods of treatment, it must necessarily fail where the want of consolidation arises from any constitutional cause. Where the preternatural joint is near to an important articulation, it is altogether inapplicable. By some writers it has been thought to be peculiarly suited to such pseudarthroses as are produced by a necrosed state of the extremities of the fragments; but in these cases, as a general rule, any very serious operation is unjustifiable, experience teaching us that it is better to leave the removal of the bone to nature, and in no way interfere until the diseased parts are separated by the absorbents, when they should be removed, and the limb afterwards supported as carefully as in cases of recent fracture. A cure by resection, it is to be remembered, is always accompained by more or less shortening of the limb—a slight inconvenience for the arm, but a matter which should enter into our calculation when the lower limb is the seat of the infirmity.

In performing the operation of resection of the ends of the bone, a longitudinal incision is to be made opposite to the point of fracture, and, in that part of the limb in which the bone is most superficial, care being taken at the same time to avoid the neigborhood of large arteries or nerves. The surrounding soft parts are then dissected from the extremities of the fragments, which are to be successively pushed out and removed with a saw, no more of the bone being taken away than is absolutely required. The ends of the bone are afterwards to be brought in contact, and the limb so placed as to favor the discharge of pus from it, care at the time being taken to retain it at perfect rest, and to treat it in every respect as a severe compound fracture.

My own experience, together with a close examination of most of the recorded cases of excision of the ends of the bones, leads me to regard it, particularly in the femur, as an operation of so formidable a nature, both as to the risk incurred by the patient and the great amount of suffering that it gives rise to, that it should never be resorted to until all other modes of treatment have failed, or are from some peculiar circumstances inapplicable.

In addition to the instances which I have noticed elsewhere, resection has proved successful in the hands of Josse,[1] Hysern,[2] Andrews,[3] Dupont,[4] and Langenbeck,[5] on the humerus: with Fricke[6] and Holscher[7] on the forearm; with Dubois,[8] Josse,[9] Dupuytren,[10] and Düsterburg,[11] in the leg; and with Viguerie[12] and Moreau, Jr.,[13] upon the femur.

Mr. Amesbury has seen the operation of removal of the ends of the bone twice unsuccessfully performed in the humerus. The first was a man of strong constitution, who, after many months' confinement, was allowed to get up. He saw him eighteen months after the operation, when the wound had healed, but the arm was much worse than when it was performed. In the second instance, after many months' suffering from exfoliation and abscesses, the man left his bed with the limb much worse than before.[14] Dupuytren lost a patient after this operation on the humerus, and derived no benefit from it in another case on the same bone.[15] Mr. James has employed it in the arm unsuccessfully.[16] Viricel lost a patient a few days after rasping the fractured extremities.[1] Mr. Allan knew the operation to fail in the hands of John Bell, whom he assisted in a case on the humerus of twelve months' standing;[2] and Physick mentions an instance in which it was performed unsuccessfully upon the humerus, and states that the patient afterwards entered the hospital in this city, where the limb was amputated, and related to him the great suffering which he had experienced in the operation of excision.[3] Resection has also altogether failed in the hands of Ansiaux,[4] Moreau,[5] Beck,[6] and Roux,[7] on the humerus, with Warmuth[8] and myself,[9] on the ulna; and Dr. Güntz, of Leipsic,[10] mentions two instances of failure after resection, of false joints, without specifying the bones operated on.

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[1] Méd. de Chirurg. Prat., p. 321.

[2] Méd. Opérat. of Velpeau, 1.

[3] Lond. Med. Journal, 1781, i.

[4] Archives Générales, ii. p. 628, 1823.

[5] Cooper's Surg. Dict.

[6] Méd. Opérat. of Velpeau, ii. p. 590.

[7] Oppenheim, p. 11.

[8] Velpeau, ii. p. 590.

[9] Mél. de Chir. Prat., p. 311.

[10] Thèse of Bérard, p, 52.

[11] Oppenheim, p. 11.

[12] Larrey, Military Surgery, trans. by Hall.

[13] Med. Opérat. of Velpeau, ii. p. 590.

[14] Op. citat., p. 216.

[15] Gaz. Méd. 1831.

[16] Retrospective Address—Provin. Med. and Surg. Trans., viii. 1840.

Of the 38 cases in the table in which resection was performed, 24 were cured, 1 amended, 7 failed, and 6 died. Of these—

12 were in the	femur,	of which	7	were cured.	
6 "	leg,	"	5	"	
12 "	humerus,	"	6	"	
7 "	forearm,	"	5	"	and 1 amended.
1 was "	jaw,	"	1 was	"	

The longest period that the fracture had existed in these cases was 5 years (adult—femur). The shortest period was 10 weeks (humerus, æt. 50).

The average period was 13 months and 19 days.

The longest period required for the cure was 13 months (femur, æt. 26).

The shortest period was 1 month (forearm). The average period was 4 months.

In 17 of the cases in which resection was employed, other methods of operating are stated to have been tried, and to have failed; of which the seton was used 6 times.

In the 38 cases in which resection was resorted to, accidents dependent upon the treatment followed, and not terminating in death, occurred 9 times (erysipelas 6; profuse suppuration and abscesses 2; phlegmasia dolens 1).

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[1] Velpeau, op. citat., ii. p. 587.

[2] System of Surgery.

[3] MS. Notes of Lectures.

[4] Velpeau, op. citat., ii. p. 590.

[5] Idem, idem.

[6] Jæger's Thesis on Resections.

[7] Thèse of Bérard, p. 53.

[8] Oppenheim, p. 11.

[9] Amer. Journ. Med. Sci., vol. v. N. S. 1843.

[10] Idem, p. 12.

Despite the constitutional and operative measures for the relief of ununited fractures which have been passed in review, the following case, under the care of a late eminent hospital surgeon of London, Mr. Key, well shows that instances occasionally are met with in which all measures will prove ineffectual, however ably they may be carried out.

"Henry Ildred, æt. twenty-five, a stout muscular man, by trade a butcher, who had never had syphilis nor taken mercury, and, in fact, never remembered a day's illness, broke his left humerus about its lower third on the 4th of November 1839. The limb was at once put up in splints and bandages, which were removed and readjusted every other day for the first fortnight; and after this once a week for six weeks, during which time he could occasionally distinctly feel the ends of the bone rub against each other. At the expiration of this time the bones were still ununited, and all treatment was abandoned for four weeks more.

"He then consulted another surgeon, who secured the limb in splints, and kept him in bed for a month, but without avail.

"He next went to Ramsgate and bathed for six weeks, but, this being equally inefficacious, he became a patient in Guy's Hospital, under Mr. Key, on the 8th of July, 1840.

"Every means that held out any prospect of producing union were made use of, but were all equally unattended with benefit. After the ordinary methods of perfect apposition, rest, pressure, etc., had met with failure, Mr. Key cut down to the separated portions of bone, and attempted, by placing wire around their extremities, to excite periosteal inflammation and so to lead to the desired union. This not succeeding, he again divided down to the line of fracture, and, having exposed the surfaces of the disjoined portions of bone, removed a thin layer from each by means of a fine saw. On this occasion, a portion of substance, having a cartilaginous appearance, apparently muscular tissue, which had become altered by pressure, was found separating the two extremities of the bone, and was removed.

"This operation having proved unsuccessful, notwithstanding a considerable degree of inflammation was excited, as a dernier resort, a seton was passed between the separated surfaces. This, however, failed equally with the other attempts in producing union, and the man left the hospital unrelieved. At one period in the course of the treatment above mentioned, he was subjected to the influence of mercury until salivation was produced, but apparently without producing any effect on the fractured ends of the bone."[1]

A remarkable instance of a similar kind in the humerus, aged 47, occurred to M. Velpeau, in which, after the immovable apparatus, frictions, and seton had been tried and failed, resection was done by him in the month of October, 1844, without benefit. In May, 1845, resection was a second time resorted to, after which the ends of the bones were drawn together and so retained by silver wire, but without any benefit.[2]

Another case, demonstrating the occasional futility of our most approved methods of treatment in ununited fractures, even in the most skilful hands, occurred to Sir Wm. Fergusson. A fracture in the middle of the thigh, which had become firmly united with deformity, was rebroken and union failed to take place. Resort was had to scraping the ends of the fragments by means of a tenotomy knife, resection of the ends of the bones, and the ivory pegs, and all uselessly. The limb was ultimately amputated.[3]

From all that has been observed in the preceding pages upon the treatment of ununited fractures, it will be seen that we recommend:—

1st. To apply the method of cure by rest and compression. If the fracture has been regularly treated, and is not consolidated at the usual period, replace the limb in the apparatus, and insure to it a state of complete immovability: if the treatment of the injury has been altogether neglected, or been inefficient, apply proper splints and moderate compression with a roller, and renew these as soon as they become in any degree lax.

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[1] A. Cooper on Dislocations and Fractures. New edit., 8vo. Lond. 1842, p. 575.

[2] Gaz. des Hôpitcaux, No. 5, 13th January, 1846.

[3] Med. Times, vol. xix. p. 33, 1859.

2d. If, from want of action in the seat of injury, rest and compression are in themselves insufficient to produce a cure, continue the state of immobility in which you have placed the limb, and apply blisters, moxas, iodine, or some other stimulant to the seat of fracture.

3d. If both of these modes fail in producing a deposition of callus, employ frictions.

4th. If the methods mentioned fail to produce a change, or the patient has already been suffering from his injury for eight or ten months, and there is no contra-indication to it, resort to the seton.

5th. If the case be one to which, from its long standing, or state of the injured parts, the seton is inapplicable, expose the fracture, and apply caustic potash to the fractured ends.

6th. If all the above means have been carefully resorted to unsuccessfully, and not till then, resect the ends of the bone.

7th. Never resort to amputation of the member until fair trials have been made with all of these methods, and then only at the request of the sufferer, after he has found that the limb can be of no possible service to him.

In employing any of the above means, the obstacle to the occurrence of union which may exist, arising from the state of the constitution, should be carefully sought for and combated by an appropriate treatment.

APPENDIX.

The accompanying table, arranged in such a manner as to exhibit the chief points in each individual case, together with the sources from whence they are derived, is added in proof of the remarks made in the foregoing pages. No reference is given which I have not myself examined, and the collection, so far as the American, English, and French journals, and surgical works are concerned, will be found tolerably complete. A number of cases might, I doubt not, be added from the German, and it is a source of much regret, that but few works in that language were within my reach.

No.	Work.	Surgeon.	Sex.	Age.	Seat of Fracture.	Period it had existed.	Operation.	Accidents which followed.	Length of time seton remained.	Duration of treatment.	Termination.	Methods of cure which had previously failed.
1	Med. Chir. Trans. ii.	Rowlands	M.	53	Femur	5 mos.	Resection	....	......	5 mos.	Perfect cure	
2	Med. Chir. Trans. v.	Wardrop	M.	Ad.	Femur	20 mos.	Seton	Arterial hemorrhage and erysipelas	21 dys.	12 mos.	Amendment	
3	Med. Chir. Trans. v.	Brodie	M.	13	Femur	5 mos.	Seton	Erysipelas	3 mos.	3 mos.	Perfect cure	
4	Med. Chir. Trans. vii.	Stansfield	M.	48	Humerus	7 mos.	Seton	....	2 mos.	2 mos.	Perfect cure	Fricts. for 5 wks.
5	Med. Chir. Trans. vii.	Boggie	M.	A.	Tibia	2 mos.	Seton	....	5 wks.	5 wks.	Perfect cure	
6	Med. Chir. Trans. xii.	Earle	M.	30	Humerus	10 mos.	Caustic potash	....	......	....	Failure	Seton.
7	Med. Chir. Trans. xii.	Earle	F.	A.	Humerus	9 yrs.	Caustic potash	....	......	....	Failure	
8	Med. Chir. Trans. xvi.	Sommé	M.	35	Femur	5 mos.	Silver wire	....	6 wks.	....	Perfect cure	Frictions.
9	Phila. Med. & Phys. Journ. ii.	Worthi'gton	F.	10	Humerus	18 mos.	Seton	....	10 wks.	10 wks.	Amendment	
10	Phila. Med. & Phys. Journ. v.	Physick	M.	A.	Lower jaw	9 mos.	Seton	....	3 mos.	....	Perfect cure	
11	Phila. Med. & Phys. Journ. xiv.	Cittadini	M.	A.	Forearm	......	Resection	....	......	1 mo.	Perfect cure	Rest and fricts.
12	Amer. Journ. of Med. Sci. iv.	Dohldorf	M.	24	Femur	14 wks.	Seton	Violent inflammation	8 dys.	3 mos.	Perfect cure	"A variety of remedies."
13	Amer. Journ. of Med. Sci. vii.	Auchinloss	M.	18	Humerus	12 mos.	Resection	....	......	13 wks.	Failure	
14	Amer. Journ. of Med. Sci. xiii.	Hulse	M.	25	Humerus	2 mos.	Injections	....	......	2 mos.	Perfect cure	
15	Amer. Journ. of Med. Sci. xiv.	Parrish	M.	27	Humerus	6 mos.	Frictions	....	......	2 mos.	Perfect cure	
16	Amer. Journ. of Med. Sci. xv.	McDowell	M.	25	Femur	2 yrs.	Seton	Considerable inflammation	14 dys.	Progress very slow	Perfect cure	Blisters and a tight bandage.
17	Amer. Journ. of Med. Sci. xvii.	Harris	M.	26	Femur	8 mos.	Resection	Erysipelas	......	13 mos.	Perfect cure	
18	Amer. Journ. of Med. Sci. xvii.	Harris	M.	24	Forearm	8 mos.	Resection	....	......	In 5 mos. ulna perfectly united.	Partial cure	
19	Amer. Journ. of Med. Sci. xvii.	Harris	M.	24	Humerus	15 mos.	Seton	Erysipelas—hemorrhage on 8th day	10 wks.	4 mos.	Perfect cure	Seton for 8 wks.
20	Amer. Journ. of Med. Sci. xvii.	Barton	M.	30	Leg	16 mos.	Resection	Erysipelas	......	5 mos.	Perfect cure	Caustic to integuments.
21	Amer. Journ. of Med. Sci. xvii.	Hewson	M.	24	Femur	31 mos.	Resection	....	......	On 16th day	Died	
22	Amer. Journ. of Med. Sci. xxiii.	Norris	M.	28	Humerus	4 yrs. & 2 mos.	Caustic potash	....	......	3 mos.	Perfect cure	Frictions.
23	Amer. Journ. of Med. Sci. xxv.	Norris	M.	12	Forearm	4 wks.	Pressure & rest	....	......	1 mo.	Perfect cure	
24	Amer. Journ. of Med. Sci. xxv.	Norris	M.	50	Femur	7 mos.	Pressure & rest	....	......	6 wks.	Perfect cure	
25	Amer. Journ. of Med. Sci. xxvi.	Fahnestock	M.	23	Radius	9 mos.	Resection	....	......	8 wks.	Perfect cure	
26	Amer. Journ. of Med. Sci. xxvi.	Fahnestock	M.	23	Ulna	14 mos.	Seton	....	5 mos.	5 mos.	Perfect cure	
27	Archives Générales.	Portal	M.	24	Humerus	2 mos.	Seton	....	21 dys.	2 mos.	Perfect cure	

No.	Work.	Surgeon.	Sex.	Age.	Seat of Fracture.	Period it had existed.	Operation.	Accidents which followed.	Length of time seton remained.	Duration of treatment.	Termination.	Methods of cure which had previously failed.
28	Med. Chir. Review, viii.	Green	M.	36	Femur	55 wks.	Amputation	....	......	....	Not stated	Pres. and rest, seton, resec. of upper end.
29	Med. Chir. Review, xiv.	Green	M.	38	Leg	2 mos.	Amputation	....	......	....	Cured	
30	Lond. Med. & Phys. Journ. 1827	Brodie	M.	24	Humerus	12 mos.	Pressure & rest	....	......	5 mos.	Perfect cure	Seton.
31	Lond. Med. & Phys. Journ. vi.	Carlisle	M.	45	Femur	15 mos.	Resection	....	......	....	Failure	
32	Dublin Hosp. Reports, iv.	Browne	M.	60	Leg	3 mos.	Seton	....	6 wks.	10 wks.	Perfect cure	
33	Edin. Med. & Surg. Journ. i.	Inglis	M.	A.	Femur	9 wks.	Frictions	....	......	Some mos	Perfect cure	
34	Edin. Med. & Surg. Journ. i.	Inglis	M.	A.	Femur	5 wks.	Frictions	....	......	5 wks.	Perfect cure	
35	Edin. Med. & Surg. Journ. i.	Inglis	M.	35	Tibia	5 wks.	Frictions	....	......	6 wks.	Perfect cure	
36	Edin. Med. & Surg. Journ. i.	Inglis	F.	20	Forearm	18 wks.	Resection	....	......	8 wks.	Perfect cure	Frictions.
37	Edin. Med. & Surg. Journ. i.	Inglis	M.	40	Leg	9 mos.	Resection	....	......	8 wks.	Perfect cure	
38	Edin. Med. & Surg. Journ. xlvii.	Macfarlane	M.	20	Humerus	17 wks.	Resection	....	......	7 mos.	Perfect cure	
39	Lond. Med. Repository, vi. n. s.	Atteaburr'w	M.	46	Humerus	3 mos.	Frictions	....	......	4 wks.	Perfect cure	
40	Lond. Med. & Surg. Journ. v	Swift	M.	28	Femur	2¼ yrs.	Seton	....	4 wks.	6 wks.	Failure	
41	Guy's Hosp. Reports ii.	Cooper	F.	28	Humerus	6 mos.	Seton	....	10 wks.	10 wks.	do	Frictions.
42	Lancet, 1834–5, pp. 783 and 522.	Brodie	M.	5	Leg	12 mos.	Scraping ends	....	......	....	do	Seton and pressure.
43	Trans. Phys. Med. Soc. of N. Y. v.	Meeker	F.	28	Radius	3 mos.	Frictions	....	......	4 wks.	Perfect cure	
44	Medical Recorder, xiii.	Weinhold	M.	52	Leg	8 wks.	Seton	....	......	13 wks	do do	
45	Medical Recorder, xiii.	do	do	26	Femur	10 yrs.	do	....	12 wks.	16 wks.	do do	
46	Medical Recorder, xiii.	do	..	40	do	......	do	....	......	5 mos.	do do	
47	Medical Recorder, xiii.	do	M.	40	do	......	do	....	......	6 wks.	Died	
48	L'Expérience, 1838, No. 27.	Thierry	F.	35	Humerus	7 mos.	Frictions	....	......	10 wks.	Perfect cure	
49	On Fractures.	Amesbury	M.	A.	do	11 mos.	Pressure & rest	....	......	7 wks.	do do	
50	do do	do	do	27	do	10 mos.	do do	....	......	6 wks.	do do	
51	do do	do	do	28	do	13 wks.	do do	....	......	5 wks.	do do	
52	do do	do	do	22	do	16 wks.	do do	Excoriations	......	9 wks.	do do	
53	do do	do	do	53	do	16 wks.	do do	....	......	3 wks.	do do	
54	do do	do	do	29	do	16 wks.	do do	....	......	5 wks.	do do	
55	do do	do	do	A.	Forearm	7 mos.	do do	....	......	7 wks.	do do	
56	do do	do	F.	74	Forearm	8 mos.	do do	....	......	7 wks.	do do	
57	do do	do	M.	39	Femur	4 mos.	do do	....	......	4 wks.	do do	Pressure and frictions.
58	do do	do	do	A.	do	66 wks.	do do	....	......	10 wks.	do do	
59	do do	do	do	55	do	11 wks.	do do	....	......	8 wks.	do do	
60	do do	do	do	29	do	19 wks.	do do	....	......	10 wks.	do do	
61	do do	do	F.	A.	Tibia	8 wks.	Pres. and frict.	....	......	5 wks.	do do	

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	Hutchison	Ad.	24	Humerus	7 mos.	Seton	Erysipelas	1 mo.	....	Partial cure	Frictions and blisters.
[illegible]	Cooper	F.	35	Femur	12 wks.	Pressure & rest	Great swelling of limb	......	14 mos.	Failure	
[illegible]	[illegible]	M.	A.	Radius	8 mos.	Seton	....	8 wks.	....	Perfect cure	
[illegible]	[illegible]	do	A.	Ulna	24 yrs	Seton	....	14 wks.	10 wks.	Perfect cure	
[illegible]	Barton	do	A.	Tibia	10 mos.	Caustic potash	....	......	12 wks.	Perfect cure	
[illegible]	Mott	do	A.	Humerus	5 mos.	Resec. & wire	....	......	12 wks.	Perfect cure	Seton for 5 mos.

	Work.	Surgeon.	Sex.	Age.	Seat of Fracture.	Period it had existed.	Operation.	Accidents which followed.	Length of time seton remained.	Duration of treatment.	Termination.	Methods of cure which had previously failed.
	Med. & Phys. Soc. v.	Raleigh	M.	39	Leg	4 mos.	Pressure & rest	....	......	5 wks.	Perfect cure	
	al Surgery.	Liston	F.	48	Humerus	18 mos.	Seton	....	13 mos.	....	Failure	Resection.
	w Med. Journ. iii.	Auchinloss	M.	74	Leg	7 mos.	Frictions	....	......	6 mos.	Perfect cure	
	Journ. of Medicine, i. 1839	Rodgers	do	26	Radius	14 wks.	Resec & wire	Slight erysipelas	......	12 wks.	Perfect cure	
	Journ. of Medicine, i.	Cheesman	do	28	Femur	9 mos.	Resec. & wire	Erysipelas	......	12 wks.	do do	Pressure & rest for 14 weeks, and afterwards immovable apparatus & salivation for 2 mos.
	n. of Medicine, i.	Cheesman	do	19	Femur	6 mos.	Pressure & rest	....	......	8 wks.	Perfect cure	
	of Medicine, i.	Not stated	do	38	Femur	5 mos.	Pressure & rest	....	......	3 mos.	Part.success	
	e, i.	Cheesman	do	28	Femur	14 mos.	Amputation	....	......	On 10th day	Died	Fricts. sal. & set. for 24 days.
	icine, i.	Cheesman	do	60	Femur	6 mos.	Amputation	....	......	Disch'd laboring under	dis. of bone	Frictions, and pressure, and rest.
	. Chir. & Pharm. i.	Derrecagaix	do	44	Leg	6 mos.	Frictions	....	......	17 wks.	Perfect cure	
	n. Med. Chir. 1838.	Guersant	do	46	Femur	9 wks.	Amputation	....	......	On 7th dy.	Died	
	hives Générales, Jan. 1839.	Seerig	do	52	Tibia	13 wks.	Seton	Severe fever accompanied with acute pain	16 dys.	6 wks.	Perfect cure	
100	Archives Générales, Jan. 1839.	Seerig	do	37	Femur	2 yrs.	Resection of sup. frag.	....	......	At end of some wks.	Died	Seton.
101	Archives Générales, Jan. 1839.	Seerig		....	Humerus	Not stated	Refus'd all treat.	Erysipelas of limb	......	....	Perfect cure	
102	Dublin Med. Press, ii. 1839.	Rhynd	F.	24	Leg	11 wks.	Seton	Violent inflammation	1 mo.	1 mo.	Perfect cure	Frictions.
103	Lond. Med. Gazette, vi.	Crosse	M.	23	Leg	9 wks.	Painted over with iodine	....	......	11 wks.	Perfect cure	
104	Ed. Med. & Surg. Jour. July, 1835.	Syme	do	50	Humerus	10 wks.	Resection	Phleg. dolens of thigh and leg	......	7 wks.	Perfect cure	Pressure & rest for 15 days.
105	Lancet for 1827.	Vincent	do	A.	Forearm	11 mos.	Rasping ends	Erysipelas	......	On 5th dy.	Died	Pressure & rest for 2 months.
106	Medical Examiner, iii.	McCook	do	36	Femur	14 mos.	Resection	....	......	3 mos.	Perfect cure	Seton for 3 mos.
107	Lancet, ii. 1835-6.	Liston	do	A.	Forearm	9 mos.	Seton	"Good deal of swelling and consid. fever"	7 days	12 wks.	Perfect cure	
108	Lond. Med. Gazette, vi.	Crosse	do	25	Leg	7 wks.	Painted over with iodine			6 wks.	Perfect cure	

No.	Work.	Surgeon.	Sex.	Age.	Seat of Fracture.	Period it had existed.	Operation.	Accidents which followed.	Length of time seton remained.	Duration of treatment.	Termination.	Methods of cure which had previously failed.
109	Medical Recorder, ix.	Barton	M.	A.	Tibia	16 mos.	Caustic potash	....	......	3 mos.	Perfect cure	Pressure & rest and frictions.
110	Essay on Non union.	Buchanan	do	18	Leg	46 wks.	Paint. over with iodine & fricts.	....	......	4 mos.	Perfect cure	Fricts. for 6 mos.
111	Journ. Complémentaire, v.	Pezenat	do	32	Femur	13 mos.	Resection	....	......	1 year	Perfect cure	
112	Encyclop. des Sc. Méd. Sept. 1837.	Oppenheim	do	30	Humerus	6 mos.	Two setons	....	3 wks.	6 wks.	Perfect cure	
113	Encyclop. des Sc. Méd. Sept. 1837.	Oppenheim	F.	44	Humerus	'Some months'	Two setons	....	3 wks.	13 wks.	Perfect cure	Fricts. & a seton as commonly passed.
114	Gazette Médicale, for 1831.	Dupuytren	M.	37	Humerus	14 mos.	Resection	Erysipelas	......	4 mos.	Failure	Pressure & rest for 3 months.
115	Med. & Surg. Register, i. part 2	Mott	M.	35	Tibia	7 mos.	Seton	....	6 wks.	3 mos.	Perfect cure	Frict.; blist.; elect'y.
116	Med. & Surg. Register, i. part 2	Mott	M.	41	Femur	12 mos.	Seton	....	12 wks.	8 mos.	Perfect cure	Frict.; blist.; elect'y.
117	Journ. Hebdomadaire, xi. & xii.	Dupuytren	M.	23	Humerus	11 mos.	Res. of sup. frag	....	......	end of 6 weeks.	Died	Pressure & rest.
118	Gibson's Surgery.	Kennon	...	25	Leg	14 mos.	Seton	....	2 wks.	9 wks.	Perfect cure	
119	Bos. Med. & Surg. Jour. xiii, 1836.	Warren	M	25	Femur	3 mos.	Pressure	....	......	3 wks.	Perfect cure	
120	N. E. Journ. of Med. & Surg. vii.	Thaxter	M.	25	Humerus	6 mos.	Seton	Profuse suppuration	5 mos.	7 mos.	Perfect cure	Fricts.; blisters.
121	Clin. des Hôp. du Midi, i.	Delpech	F.	22	Radius	12 wks.	Seton	....	4 wks.	8 wks.	Perfect cure	Pressure.
122	Lond. Med. Gazette, ii. 1838-9.	Bennett	M.	18	Femur	10 mos.	Resection	Abscess and hec. followed		resorted to 2 mos. after res.	Failure	Frictions.
123	Amer. Journ. of Med. Sci. ii.	Wright	M.	A.	Tibia	14 wks.	Pressure & rest	....	......	5 wks.	Perfect cure	
124	Amer. Journ. of Med. Sci. ii.	Wright	M.	61	Tibia	8 wks.	Pressure & rest	....	......	6 wks.	Perfect cure	
125	Amer. Journ. of Med. Sci. ii.	Wright	M.	A.	Ulna	5 wks.	Pressure & rest	....	......	8 wks.	Perfect cure	
126	Lond. Med. Gazette, Aug. 1834.	Macdowell	M.	52	Humerus	4 mos.	Seton	Profuse suppuration	10 dys.	Not stated	Failure	Rest & pressure and mercury.
127	Clinique Chirurg. i.	Larrey	M.	A.	Humerus	Not stated	Seton	....	5 dys.	A short time	Died	
128	Abernethy's Lectures.	Long	M.	A.	Humerus	Not stated	Resection	....	......	Not stated	Failure	
129	Lonsdale on Fractures.	Mayo	M.	A.	Humerus	3 mos	Seton	....	......	Not stated	Perfect cure	
130	Amer. Journ. of Med. Sci. i. n. s.	Hays	F.	26	Humerus	6 mos.	Pressure & rest	....	......	3 mos.	do do	Frictions, and caustic to integuments.

No.	Work.	Surgeon.	Sex.	Age.	Seat of Fracture.	Period it had existed.	Operation.	Accidents which followed.	Length of time seton remained.	Duration of treatment.	Termination.	Methods of cure which had previously failed.
131	Gaz. des Hôpitaux, Sept. 1840.	Jobert	M.	40	Humerus	3 mos.	Seton	....	8 dys.	3 mos.	Perfect cure	
132	Dublin Med. Press.	Donovan	F.	A.	Forearm	3 mos.	Seton	....	......	4 wks.	do do	
133	Eclectic Repertory, iii. 114.	Hartshorne	M.	A.	Femur	4 mos.	Caust. to integs.	....	......	3 wks.	do do	Rest & pressure for three wks.
134	Eclectic Repertory, iii. 114.	Hartshorne	M.	24	Humerus	5 mos.	Caust. to integs.	....	......	3 mos.	do do	
135	Lon. Md. & Phys. Jour. ii. n.s. 530.	Wickham	F.	35	Tibia	14 wks.	Resection	....	......	Not stated	do do	
136	Méd. Opérat. of Velpeau, ii. 591.	Halgout		A.	Femur	5 yrs.	Resection	....	......	1 mo.	Died	
137	Lon. Md. & Sur. Jour. iii. 78, 1829	Lyford	M.	C.	Femur	11 mos.	Seton	....	13 dys.	2 mos.	Perfect cure	Blisters.
138	do do do vi. vii. n. s. 1814.	Keate	F.	A.	Humerus	13 mos.	Resection	....	......	5 mos.	Failure	A seton by which a large bloodvessel was wounded, and hemor. restrained with difficulty.
139	Dub. Med. Press, March 18, 1840.	Enright	M.	48	Tibia	6 wks.	Seton	....	5 wks.	5 wks.	Perfect cure	
140	Case Book of Penn. Hosp. i. 88.	Physick	M.	30	Tibia	2¼ yrs.	Seton	....	3 mos.	3 mos.	Perfect cure	
141	Case Book of Penn. Hosp. i. 108.	Physick	M.	27	Femur	8 mos.	Seton	Fever, and after some weeks an extensive abscess of thigh	4 mos.	....	Failure	
142	Gazette Médicale, July, 1840.	Bonnet	M.	27	Femur	Not stated	Pressure & rest	....	......	Several months	Fail. & amp.	
143	Lond. Med. Gazette, i. 1837–8.	Banner	M	30	Femur	9 mos.	Resection	....	......	6 wks.	Perfect cure	Blisters & fricts.
144	Lancet, ii. 1826–7.	Green	M.	65	Femur	6 wks.	Pressure & rest	....	......	9 wks.	Failure	
145	Lancet, ii. 1826–7.	Wardrop	M.	23	Humerus	10 mos.	Seton	....	8 dys.	3 wks.	Perfect cure	
146	Lancet, i. 1829–30.	Fricke	M.	35	Forearm	7 mos.	Resection	....	......	10 wks.	Perfect cure	Rest & pressure for several weeks.
147	West. Journ. of Medicine, 1841.	Donne	M.	23	Tibia	10 wks.	Seton	....	17 dys.	10 wks.	Perfect cure	Frictions.
148	Trans. Med. Soc. of N. Y. 1816.	J. White	M.	28	Tibia	2 yrs.	Rasping ends	....	......	3 mos.	Perfect cure	
149	Brit. & For. Med. Rev. xii. 1841.	Woppish & Bauer	M.	A.	Femur	15 wks.	Frictions	....	......	A few wks	Perfect cure	
150	Méd. Opératoire, ii. 585.	Velpeau	F.	A.	Humerus	30 wks.	Pressure & rest	....	......	2 mos.	Perfect cure	

SUMMARY.

Of the above one hundred and fifty cases of ununited fractures—

48	occurred	in the femur,	of which	31	were cured,	9	without benefit,	6	died,	2	result not stated.
33	"	in the leg,	"	32	"	1	"				
48	"	in the humerus,	"	31	"	14	"	3	"		
19	"	in the forearm,	"	17	"	1	"	1	"		
2	"	in the jaw,	"	2	"						

Of	46	cases in which the	seton[1]	was employed,	36	were cured,	3	partial cures,	5	no benefit,	2	died.
"	38	"	resection[2]	"	24	"	1	"	7	"	6	"
"	36	"	pressure and rest		29	"	1	"	6	"		
"	8	"	caustic	"	6	"			2	"		
"	11	"	frictions	"	11	"						

Of 11 cases in which other methods[3] were employed, 7 were cured, 1 received no benefit, 2 died, 1 result not stated.

The results in the preceding table exhibit, probably, with tolerable accuracy, the success of the seton and resection, though not of the other methods of treatment, which, being milder, were in several of the cases employed before the two just named and more severe ones were resorted to. Thus it would appear as if all the cases treated by frictions had been cured, whereas, in fact, in the 36 cases cured by the seton, frictions had been unsuccessfully tried in 8 of them; and in the 24 cases cured by resection, they had been equally unavailing in 5 of them. This will be seen by referring to the table, but could not be exhibited in the summary without complicating it more than we desired.

Of 112 cases in which the age is noted, there were—

between 10 and 20	14
" 20 and 30	53
" 30 and 40	21
above 40	24

From the tables and summary the following conclusions may be drawn:—

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[1] Including the methods of Weinhold, Sommé, Oppenheim, and Seerig.

[2] Including all cases in which the ends of the bone were scraped, rasped, or excised.

[3] Iodine, 3, all cured; Injections, 1, cured; Erysipelas, 1, cured; Hot Iron, 1, cured; Amputation, 5, 1 cured, 2 died, 1 failed, 1 not stated.

1st. That non-union after fracture is most common in the thigh and arm.

2d. That the mortality after operations for its cure follows the same laws as after amputations and other great operations upon the extremities, viz., that the danger increases with the size of the limb operated on, and the nearness of the operation to the trunk; the mortality after them being greater in the thigh and humerus than in the leg and forearm.

3d. That the failures after operations for their relief are most frequent in the humerus.

4th. That after operations for the cure of ununited fractures, failures are not more frequent in middle-aged and elderly than in younger subjects.

5th. That the seton and its modifications is safer, speedier, and more successful than resection or caustic.

6th. That incising the soft parts previous to passing the seton augments the danger of the method, though fewer failures occur after it.

7th. That the cure by seton is not more certain by allowing it to remain for a very long period, while it exposes to accidents.

8th. That it is least successful on the femur and humerus.

ON THE TREATMENT OF DEFORMITIES FOLLOWING UNSUCCESSFULLY TREATED FRACTURES.

IRREGULARLY united fractures sometimes fall under the notice of the surgeon, attended with so much shortening or deformity as to render the limb unsightly, painful, or altogether useless, and although the sufferers in such cases are generally eager for relief, yet the general practice has been, at least in this country and Great Britain, to abstain from any operative measures for the remedying of such states. Operations, however, have been often proposed and practised for the removal of vicious consolidations, and, believing them to be frequently remediable, we think it well to call the attention of the profession to this interesting subject, by bringing to their notice the various methods by which it may be done, and recalling to memory the different numerous instances in which they have succeeded.

The means proposed for the removal of deformities following fractures, are of three kinds. The first consists in straightening a crooked limb by means of well-applied pressure; the second, in re-fracturing the bone at the point of former injury in order by an after-treatment to give it a better direction; and the third, in making a section of, or removing the projecting or angular portions of bone, which give rise to the deformity.

1. *Pressure and extension of the limb.*—The researches of Duhamel, Breschet, Dupuytren, and others, upon the formation of callus, have proved beyond cavil the possibility of straightening deformed limbs at considerable intervals after the occurrence of fractures, by means of pressure, conjoined with extension and counter-extension. This method, however, is applicable only to those cases in which the callus has not yet acquired all the solidity of bone, an event which in the

majority of cases does not occur till the fiftieth or sixtieth day. Dupuytren furnishes examples of limbs straightened by this method as late as the one hundred and twentieth day after the receipt of the injury, and fixes upon the sixtieth day as the medium time at which benefit is likely to be derived from it. In bringing about straightening of the limb, extension and counter-extension are to be employed in the same manner as in cases of recent fracture, the limb being drawn down with some force every second or third day, care being taken at the same time to keep, by means of the extending apparatus, what is gained by these forcible efforts.

Sometimes, however, when the callus is very yielding, the parts may be dragged at once to a better position, and so retained, though generally the contracted state of the muscles accompanying these cases prevents this being done.

Extension and pressure made with the aid of machinery have also been successfully applied to the remedying of these as of other deformities, and sometimes with marked success. An instance of this is related in the *Transactions of the Medical Society of Lyons*, by M. Desgranges. The case was that of a female, who being badly treated in a chirurgical point of view after a fracture of the leg, found the limb, at the end of four months, so crooked that she was obliged to walk on the exterior edge of the foot. M. D. undertook to remedy this defect, and by means of a machine, making well-applied pressure on the protuberant angle of the fracture, obtained perfect rectitude of the leg.

A most instructive case has been reported by Dr. Michener, of Chester County, Pa., in which, after a fracture of the femur at its upper third, where the limb was considerably shortened and deformed, and the fractured part surrounded by a spongy callus of four or five inches in diameter, by means of extension and counter-extension, aided by pressure over the projecting point, applied ten weeks after the accident, the extremity was gradually brought into a good position and an excellent cure effected.[1]

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[1] Amer. Journ. of Med. Sci., vol. xv. new series, 1848.

2. *Rupture of the Callus.*—Among the ancients, some of the surgical writers of authority recommended and practised in these cases the rupturing of newly consolidated bones, while others strenuously opposed it. In modern times, the practice was revived by Œsterlen, and has received countenance from practitioners of eminence on the continent of Europe; Richerand, Dupuytren, Velpeau, and many others, admitting of its employment in certain extreme cases. Such being the case, it will be well to examine its claims to attention, and cast a retrospective glance at the judgments passed upon the method by the recognized authorities in our science, as well for the purpose of exposing its dangers, as of learning the benefits which in some cases may be derived from it.

The earlier of the ancient writers who recommended the rupturing of the callus produced it by means of blows with a hammer or other similar means, the member being previously covered, and, protected to prevent injury to the soft parts, and, when done in this manner, we can well conceive that it would be likely to be followed with serious consequences. Rhazes, who particularly noticed this practice among the surgeons of his time, boldly opposed it, urging the danger of fracturing the bone elsewhere than at the seat of previous injury, and recommended the adoption of emollient applications, with pressure and extension in lieu of it. Haly Abbas speaks of an old man with a deformity following the consolidation of a fractured thigh, who died from the effects of the rupturing operation.

Guy de Chauliac, in cases where the callus was not older than six months, recommends to break the bone again at the same point with the knee, after having used emollient and relaxing applications, and afterwards treating it as a recent fracture.

Ambrose Paré speaks of the operation only to condemn it, except in cases where the callus is still soft, and the extremity so much deformed as to hinder the patient from using it, and even in these instances, before proceeding to the straightening of the limb, he advises the softening of the new growth by means of plasters and emollients, for fear of breaking the bone at some other point than that at which it had first given way.

Fabricius Hildanus rejects the operation, affirming at the same time that neither Hippocrates nor Galen practised it, and supports his opinion against its employment by the experience of Paré, Jessen, Guy de Chauliac, Albucasis, and Avicenna, all of whom were opposed to the forcible rupturing of the bones after firm union.

Purmann[1] recommends relaxing applications when the arm or leg presents deformities which are not of long duration, and afterwards extension of the member by means of certain instruments, as the glosso-comium. But, if the callus had already attained perfect firmness, after the use of the same topical applications, he advises rupturing of the bones at the point of previous fracture by means of a machine worked by a screw, which is accurately described by him. Passing over the opinions of many esteemed writers, though of less authority on the particular subject of which we are treating than those we have just quoted, it may be well to dwell for a few minutes on those of some of the authors who have written upon the subject nearer to our own times.

Morgagni[2] speaks of the operation of rupturing the callus and straightening the limb, as having to his knowledge succeeded in some cases, but at the same time adds, that an instance was known to him, in which the same operation upon the leg was followed by death. Duverney, who in an especial manner studied the injuries to which the bones are liable, remarks, that deformity after fractures "has determined many to the expedient of breaking the thigh anew, in order to remedy it. But this operation has been unsuccessful, nay on the contrary even, they have been in a worse state than otherwise they would have been in."[3]

In a work in our own language which is deserving of more frequent reference than it now receives, we find the following:—

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[1] Œsterlen, Sur la Rupture du Cal, p. 18.

[2] Epist. 56, p. 154; vol. ix. 8vo. Paris, 1824.

[3] Trans. by Ingham, p. 137.

"The crooked limb left after a fracture is very common, and, admit the callus has been a month, but especially of a longer date, I see little likelihood of remedy. The breaking asunder forcibly the new cement at these times has, I think, but rarely answered. Nor are we sure, after this second rupture, of success. From the larger bones, as of the leg, but particularly of the thigh, thus served to gratify some more nice than prudent people, I have known *abscesses* arise, and the *fracture*, before *simple*, now made *compound*, by a new afflux of humors; at length *rigors* and *convulsions* have ensued, and carried off the patient"—"others, though with less hazard to their lives, I have known fare little better as to the straightness of their limbs; and some, after the pain they have hereby undergone, have been left worse than before."[1] Heister,[2] however, thinks that "when the callus is tender, and the patient young and vigorous, the operation may be fairly attempted," but nevertheless hints, that, if the deformity and hindrance from the fracture are but slight, it is better to avoid the operation, as it is neither free from pain nor danger.

In a fracture of the thigh badly treated, and cured with considerable shortening, Ten Haaff ruptured the callus and made a cure without shortening.[3]

To rupture the callus, Œsterlen employed a complicated machine modified from those of Purmann and Bosch, the principle of which consists in having a pad attached to a piece of plank which by means of screws is made to descend gradually, and press upon the convex surface of the callus, the deformed limb having been previously fixed upon another padded plank to which they are attached. A sketch of this machine is figured in his work, but all that is sufficient, where this process is adopted, is, to fix the limb to be operated on upon a firm mattress or table, while at the same time pressure is made *suddenly* and firmly by means of the hands or knee of the surgeon. A number of facts collected by Œsterlen from the older writers, as well as those given by him as occurring either in his own practice, that of Bosch, or of other surgeons of his country, clearly show that the fracture following the rupture of the callus is generally exempt from contusion, or other serious complication, and that it may be cured as readily as an ordinary simple fracture. Setting aside, however, the statement of the acknowledged advocate of this mode of practice, facts will at once present themselves to the mind of every surgeon to show the facility with which the callus of broken bones may be fractured, and the little danger attendant upon its rupture, previous to the deposit of that substance in its definite form, that is, previous to the lapse of four or five months, as well as to prove that bones recently consolidated give way more easily at the first point of injury than elsewhere. These facts are not unfrequently witnessed by patients refracturing their limbs by falls a considerable time after convalescence from previous like injuries, in whom, although in some cases produced by great violence and accompanied with much contusion, we find consolidation to proceed as regularly as after their first fracture.

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[1] Turner. vol. ii. p. 189, 90, 2d ed. Lond. 1725.
[2] System of Surgery, p. 117. London, 1743.
[3] Dezeimeris, Dict. Histor., tom. ii. p. 678.

In considering the propriety of straightening or rupturing the callus, it becomes interesting to inquire into the degree of force requisite to produce it. M. Jacquemin in his Thesis,[1] which is understood to embody the views of Dupuytren on this subject, has endeavored to represent by weights the force necessary to break the callus in its different periods, and the results of his experiments are in the highest degree interesting, as showing that, at a period when the fractured limb is ordinarily removed from the retentive apparatus, rupture of the callus will occur upon the application of a moderate degree of force.

The short end of a femur which was surrounded by a regular callus, taken from an adult on the 45th day after a fracture, was fixed horizontally upon a table in such a way that the callus projected from it, a scale beam being attached to the extremity in which weights were gradually placed. At 56 pounds the part bent without tearing, and at the 60th pound, the callus was completely ruptured. In a second experiment a callus of 59 days was torn off at the 56th pound. In these experiments the bones have been used as levers to aid in breaking the callus, and the amount of force required has been, therefore, underestimated; nevertheless they show the tendency to give way when they do break at the previous point of fracture.

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[1] No. 140. Paris, 1822, quoted from Laugier's Thesis.

Previous to the appearance of M. Jacquemin's work, Bosch and Œsterlen had experimented upon bones after fracture in a somewhat similar way, and conclusively proved that the callus, even when more ancient than in the experiments already cited, gave way upon the application of force sooner than the original bone.

The leg of an ox, three years old, which had become firmly consolidated after fracture that had occurred 28 weeks previously, with shortening of the limb to the extent of an inch and a half, was fixed by its extremities on two pieces of plank; the screw of a jack was then applied on the convex surface of the callus, which was fractured by a few turns of its handle without the production of splinters. The bone of the opposite leg, treated in the same way, required the application of much more force to produce its fracture.

The thigh of a goat two years old, which had been fractured fifteen months and a half previously, and become firmly consolidated with deformity, was submitted to the action of Œsterlen's machine, and after a few turns of the screw the callus was fractured transversely in its middle. In a third experiment, the humerus of a woman, aged 81, which was firmly united six weeks after its fracture, was fixed upon two blocks at a little distance one from the other, the callus projecting between them, and by pressure made with a round stick held in the hands of the operator, a clean fracture of the callus was produced.

Besides these direct experiments upon the callus, numerous observations of the accidental rupture of bones united after fracture might be adduced, to show that for a length of time after consolidation of the original injury, rupture of the callus is feasible, is generally cured promptly, and has been often followed by marked benefit to the patient.

The possibility of straightening or of rupturing the callus after its deposit being admitted, a question arises as to whether or not it should be preceded by any preparatory local treatment, with the view of producing softening of this substance. Nearly all of the older writers recommend the use of fomentations, cataplasms, ointments, mercurial plasters, or warm bathing, with a view not only to their relaxing effects upon the soft parts, but also for those upon the callus, which they believed to become more supple, and apt to give way more easily after their employment. Of these applications, the moderns have found some to be altogether without value, while others of them have been thought by practitioners of note to merit the notice claimed for them in certain stages of the formation of callus. According to Duhamel, the use of douche baths produces such powerful effects in mollifying recently deposited callus, as to bring about, if often repeated, the complete separation of the fractured fragments. Richter asserts the repeated use of warm baths to be a powerful means of softening the callus of firmly consolidated fractures, particularly in those of rather advanced age, and Brieske[1] and other writers affirm the use of the mineral waters of Carlsbad and Barège to produce in a remarkable degree softening of this substance. Dupuytren, too, whose practical judgment and close observation of facts must be unquestioned by all, was fully persuaded of their good effects, and never attempted the straightening of a deformed callus in the lower limbs without enveloping the part for several days previously in emollient cataplasms and strictly enjoining the use of local baths; so firm, indeed, was his conviction in the efficacy of bathing for this purpose, that M. Laugier[2] affirms, that for fear of producing this effect he has often refused to allow baths to his patients who were convalescing after fractures. These means, however, can be of avail only before the deposit of the definitive callus, and must be more useful the nearer we approach the period of original injury, and it would be evidently improper to delay for any length of time an attempt to rectify a bad position of a limb in order to make trial of them, where a comparatively long period had already elapsed from the occurrence of the accident.

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[1] Gazette Médicale, June 8, 1839.

[2] Des Cals Difformes, Thèse. Paris, 1841, p. 41.

It is a matter of much importance to determine accurately the cases to which re-fracture of the limb is applicable—more particularly the precise degree of deformity demanding it, and the lapse of time after which it would be proper to undertake the operation. The recorded cases of the operation have been most generally in young and robust subjects where the callus was still recent, and where the deformity was either considerable, or interfered more or less with the use of the member. The procedure, however, is not adapted to all cases of irregularly united bones. It is only where an angular deformity exists, arising from the union of the fragments by their extremities, that rupture of the uniting medium can be attempted with any good prospect of success. Where there is shortening of the extremity from the ends of the bones slipping past each other, even supposing that the rupture could be effected, union in the majority of cases would not follow in consequence of the extremities having become rounded and smooth.

The observations of rupture of the callus, detailed in the work of Œsterlen, either by the hand alone, or with the aid of a machine, amount to seventeen in number, of which, ten were in the femur, five upon the leg, and two on the arm, in none of which did any very severe symptoms follow the operation. Seven of these seventeen cases were in children, and ten in adults. The greatest length of time which had elapsed between the period of fracture and that of the operation, was six months, the shortest time, one month. The longest period required for the cure after rupture, was twenty weeks, the shortest period, four weeks, and in most of the cases operated on, very considerable deformity and shortening are stated to have been present. In no case did union fail to take place after it, and in all great benefit is reported to have followed it.

In the *Gazette Médicale* for 1840, three cases are detailed by Mr. Pfluger, which go to confirm completely the statements made by Œsterlen. The first was the case of a man ætat. 64, who fractured his leg, and who, in consequence of bad treatment, was unable afterwards to walk without crutches. The patient desired to have the leg broken over, which operation was done by M. Bosch, after the method of Œsterlen; it had perfect success, and ten weeks after the new fracture the patient could walk well, having but slight shortening.

The second case was that of a boy ætat. 16, with a fracture of the femur in its middle part. Consolidation had taken place with the fragments crossing each other, with inclination of the inferior end outwards and forwards, and shortening to the extent of eleven centimetres; artificial rupture was practised, and extension afterwards made use of. In two months, consolidation was perfect, the two members being of equal length.

The third case was a youth ætat. 17, with fractured femur, the fragments of which had united at a considerable angle. The limb was shortened eight centimetres, and the patient was scarcely able to touch the ground with the point of his toes. Eighteen weeks after the accident, Dr. Gruel ruptured the callus with the machine of Œsterlen. Extension was afterwards made upon the limb, and at the end of three months the patient was moving about on crutches, with a shortening of only six millimetres.

M. A. Thierry has recorded[1] the case of a fractured radius which was straightened by rupturing the callus, after perfect consolidation attended with much deformity.

Dr. Mussey, in a case of deformed and useless leg, resulting from a fracture, ruptured the callus and straightened the limb several months after the injury, and in two months the bones were firmly consolidated in a good position.[2]

Mr. Butcher relates a case of fractured femur, aged 19, in the upper third, attended with shortening and great deformity, in which the union at the end of thirty days was firm enough to allow the entire weight of the body to be borne upon the limb, where re-fracture was resorted to, and resulted in a cure so perfect that not the slightest halt or trace of the original deformity was perceptible.[1]

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[1] L'Expérience, Nov. 1841.

[2] Amer. Journ. Med. Sci., vol. xxi., New Series, 1851.

Dr. Gurdon Buck, of New York, has reported six cases of fractures of the femur, all of them accompanied with considerable deformity and shortening, in which he resorted to re-fracture: of these cases, one was aged five years, and the fracture of five months' standing; three were aged nineteen, two of them being of six, and one of eight, weeks' duration; one aged twenty-one, five weeks after the accident; and one twenty nine, sixteen weeks after the accident: and in all of them succeeded in making good cures. The rupture in all these cases was made with the hands, at the same time that extension and counter-extension was resorted to, and in none of them was the procedure followed by inflammation sufficient to prevent the immediate application of means to keep the limbs extended. In two of the cases, aged respectively nineteen and twenty-nine, no motion existed at the seat of fractures.[2]

Mr. Skey believes that re-fracture of the bones may be effected without difficulty or danger at a term beyond that usually prescribed as the limit at which it is justifiable. He relates six cases—two of the thigh, at the periods of 77 and 75 days from the date of the injury—two of both bones of the leg at the 74th and 45th days (the latter in a child six years of age), and one of both bones of the forearm at the expiration of 120 days, in which all did well. In another case the attempt to re-fracture a thigh at the end of nine months was unsuccessful.[3]

According to Velpeau,[4] M. Jacquemin proves that the dangers of artificial rupture have been singularly exaggerated, and he himself thinks it shown beyond question, that bones newly consolidated are more easily fractured at the point of primitive injury than elsewhere, and holds as a general rule, that the second fracture becomes consolidated more easily and promptly than the primitive one. He would limit us, however, to three months, for attempts upon limbs presenting simple shortening from the fragments passing each other, though he looks upon efforts to rupture angular deformities always allowable, however long the period which may have elapsed since consolidation has occurred.

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[1] Operative and Conservative Surgery, p. 481, 1865.

[2] Trans. of N. Y. Acad. of Medicine, vol. i., 1855.

[3] Med. Times and Gaz., Jan. 22d, 1859.

[4] Médecine Opératoire, 2d ed., 1839, tom. i.

Though generally unattended with dangerous consequences, yet still it is well to recollect that these have occasionally followed rupturing of the callus. Haly Abbas, as already mentioned, relates that in an old man of 70 years of age, where a re-fracture was made to remedy a deformed thigh, death occurred from the effects of the operation. Morgagni gives a like instance, and Laugier asserts,[1] that a similar result has been observed in Germany. The callus in this case was of nine months' duration, and the femur the seat of the injury; the re-fracture was produced by strong extension made with the pulleys, and death followed an hour and a half after the operation.

Dr. Whitridge has published a case of fracture of both bones in the middle of the forearm which had united with great deformity of the limb, where the callus was broken up, and the fracture afterwards well treated by suitable splints, but no union ever took place, the arm remaining almost as flexible at the point of injury as at the wrist.[2]

Dr. Hunt[3] gives a case where a sailor fell from the rigging, and broke both bones of the leg about the middle. He was treated at sea for three weeks and then in an English hospital. Remarkably firm bony union had taken place and great angular deformity, only a limited portion of the internal edge of the foot could be brought to the ground. A small external incision was made and a large sized drill applied to the bone, perforating it in three or four different directions. The bone was then snapped asunder by manual force, the fracture taking place with a loud crack. The tendo Achillis was then divided subcutaneously and the limb with an external pasteboard splint put at rest in a fracture box. There was great shock at first, followed by hepatitis, pleurisy, and a deep gangrenous slough at the wound. Several pieces of bone came away; for a time his life was despaired of, but the symptoms ameliorated gradually, the wound healed, and the fracture became firmly united in good position. I am informed by Dr. H. that a year after his discharge from the hospital he had been doing full duty as a seaman for several months.

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[1] Loc. cit., p. 62.

[2] New England Med. Rev. and Journ., vol. i., 1827.

[3] Phila. Med. Times, vol. iii., 1872.

The treatment after re-fracture of a bone in no way differs from that usually employed in ordinary solutions of continuity of the bony fibre. If possible, the limb should be at once stretched to its proper length, or at any rate brought into a good position, and so retained by means of an appropriate apparatus, till the consolidation is effected, care being taken, where much shortening has existed, to make the extension in such a way as not to provoke severe inflammatory action.

3. *Resection.*—In cases where objection has been made to rupture of the callus, where this is impossible to attain by the application of a safe degree of force, or where the deformity is of very long standing, and the union has taken place at any considerable angle, division, or resection of a portion of the bone, has in numerous instances been performed, and followed with successful results. As these operations do not appear to have received the attention which they merit, the following abstract of them, embracing many of those to be found recorded, is given.

Resection of a projecting portion of the femur, following a badly set fracture, is reported to have been successfully practised in 1521, upon the famous Jesuit, Ignatius de Loyola, then aged 28 years.

Gardiel, the translator of Hippocrates, relates in that work, that, in the case of his own nephew, a like resection was performed on the bones of the forearm, and that the operation was perfectly successful.

Wasserfuhr, of Stettin,[1] in 1816, separated and resected the femur, in a child aged five years, to remedy an angular deformity of that bone above its middle part, following a badly set fracture. The fractured bone was consolidated in such a manner as to form nearly a right angle, and the limb was shortened to the extent of *twelve fingers' breadth.* The operation was difficult, and followed by severe symptoms, but the patient recovered. We must here remark, that, though successful, we do not think any similar operation to be either called for or ever justifiable in a child of five years.

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[1] Lancet, vol. i., 1828–29, p. 521, from Rust's Magazine.

Riecke, in 1827,[1] in a patient aged 20, with a badly united fracture of the femur—the limb being shortened nearly a foot—incised the soft parts from the great trochanter to the external condyle, divided the callus with a saw, and afterwards removed the end of the superior fragment of the bone. A perfect cure was obtained in eight months, the member having been restored by permanent extension to nearly its natural length.

M. Clémot,[2] surgeon-in-chief of the marine at Rochefort, has in two instances resected portions of the femur, in order to remove great deformities resulting from badly treated fractures. The first case was in a child in whom the treatment by extension, though persisted in for several months, had failed. The operation was done in December, 1834. A longitudinal incision, two inches in length, was made over the callus, and the bony angle fairly exposed. The fragments had united at an angle of about 112 degrees. Spatulas were placed beneath the bone in opposite directions, in order to protect the soft parts, and the angular projection protruded. With a small saw, a section perpendicular to the axis of the superior fragment was made, including but two-thirds of its thickness. A like section was then made for the inferior fragment. The loss of substance was not great, and was at the expense of the callus. The limb was then placed in a good position, and the fragments maintained in apposition. Seventy days after the operation the child was removed to Bordeaux, having the limb straightened and lengthened.

The second case was that of a husbandman, ætat. 27, who, fourteen months and a half previous to the operation, had met with a fracture of the left thigh, a little above its middle. After the cure, the femur remained deformed, and bent to an angle of 130 degrees—the summit of this appearing at the external and anterior part. The limb was shortened five inches; the leg and the foot carried inwards, and the patient unable to walk. The callus was perfectly firm. Resection of the angular projection was made in February, 1835, and the limb afterwards placed on a double inclined plane. Seventy days after the operation, the inclined plane was removed, the leg and thigh being still kept in a state of semi-flexion, and but slight motion allowed. The date of his discharge is not mentioned, though it is stated that he was able to support the weight of his body on the limb, and had a lameness scarcely perceptible.

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[1] Archives Générales, September, 1828.

[2] Arch. Générales, 2me sér., tom. ii. p. 235.

In a case of deformity after a fractured leg, in which the sharp edge of the tibia projected against the skin, so as to occasion much pain and deformity, and considerable difficulty in setting the foot against the ground, Mr. Dunn, of Scarborough,[1] in 1821, made a semilunar incision of the integuments, turned them backwards, and with Hey's saw amputated the sharp angle of the bone. The leg by this course was made much straighter, and the patient afterwards walked well.

In 1827, a case fell under the notice of Mr. Duncan,[2] in which a fragment of the femur of a man aged 22 projected outwardly, at a point above the middle of the thigh, to so great a degree that it seemed scarcely covered by soft parts, and formed with the other portion of the bone nearly a right angle. This deformity had followed the treatment of a compound fracture of the thigh received a year previously, and almost entirely prevented the man from walking. Mr. D., after exposing this projecting piece of bone, which was externally sharp and nearly an inch and a half in length, cut it off with a large pair of bone-pliers. The edges of the wound united by the first intention, and the patient did well.

In 1823, Dr. Warren, of Boston (communicated to author by

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[1] Medico-Chirurgical Transactions, vol. xii. p. 181.

[2] Lancet, 1827–8, vol. i. p. 25.

Dr. J. Mason Warren), sawed out a cuneiform fragment of the tibia at its most prominent part, in a case of deformity following a fracture which had occurred nine months previously at sea. The patient was 22 years old, and the leg was greatly curved inwards. After removal of the wedge, the base of which was two inches in length, the fibula was broken by manual force, and the parts straightened and secured by splints. The union was perfected in four weeks.

Dr. Parry, of Indiana,[1] in a young subject, who had met with a fractured leg two years before, which had been suffered to unite at an angle almost equal to a right angle, in 1838 exposed the bones, and sawed a little cuneiform block out of the angle of each; in a little more than two months after, the patient was discharged cured, the leg being straightened and increased three inches in length.

Mr. Key, in October, 1838,[2] performed a similar operation upon a gentleman who met with a fracture of the tibia in August, 1835. The shortening occasioned by the deformity in this case was such as to cause the patient to walk on his toes, the heel being raised an inch and a half when he stood upright. The tibia was divided on the 14th of October, and by the 18th of January following the bone had firmly united, the limb having acquired a good position and appearing but little less than its fellow.

Professor Portal, of Palermo,[3] has also operated successfully on two like cases. The first was in a patient aged 32, in whom a fracture of both bones of the leg, near their middle, had united in an irregular manner. An incision was made over the angular projection, and about an inch of the bone removed by the chain-saw. The limb was then carefully extended, and a cure procured in forty-eight days, the wound having united by the first intention. Very little shortening occurred.

The second case was that of a woman in whom the fractured ends of the femur had united so as to form an angle at the point of union. The ends of the bone were cut down on, and an inch and a half removed from the upper fragment, after which half an inch was sawn off from the lower. The limb was maintained in a state of permanent extension. Fifty-five days afterwards she was dismissed cured, with the limb perfectly serviceable, though shortened to the extent of two finger-breadths.

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[1] Am. Journ. of Med. Sci., vol. ix. 1839.

[2] Guy's Hospital Reports, April, 1839.

[3] Am. Journ. of Med. Sci., vol. iii. N. S. 1842.

In 1839, a boy aged fourteen years fell under the notice of Dr. Stevens (communicated in a letter from Dr. Watson, of New York), in whom the leg had been fractured eight years previously, and had been suffered to unite in such a way that its lower part was bent inwards and backwards, nearly at right angles with the upper. For the purpose of remedying this deformity, Dr. S., after exposing the bones, sawed out a wedge-shaped piece from the angle of the tibia, and another from that in the fibula, and then, after a subcutaneous division of the tendo Achillis, straightened the leg and brought the bones into careful apposition. The case was subsequently treated as one of compound fracture, at first by Amesbury's apparatus, and afterwards by the starched bandage. Notwithstanding every attention, however, union failed to occur, and, about a year after the attempt to straighten the limb had been made, amputation became necessary, and was successfully done by Dr. Watson.

In a patient 23 years of age, affected with a deformed and shortened leg consequent upon an unsuccessfully treated fracture, received ten months previously, Dr. Thomas D. Mütter[1] resected the extremities of the bones with success, the patient walking without difficulty eight months after the operation.

In 1841 Dr. J. R. Barton[2] operated for the relief of deformity of the leg following a fracture. In this case, the extremity of the upper fragment of the tibia projected inwards, overlapping the lower one about half an inch, and the limb, besides being shortened and deformed, was weakened, and the footing of the patient rendered uncertain, the whole foot being thrown outwards. The parts being exposed, the extreme ends of the bone were sawn off, and the transverse bridges which connected the tibia and fibula together were removed by the chisel and bone-nippers, and the fragments brought into perfect coaptation, and so retained. By the end of the fourth week, bony union was so far advanced as to admit of the limb being rolled about the pillow, and on the fortieth day he arose from his bed with a straight and sound limb.

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[1] Am. Journ. of Med. Sci., vol. iii. N. S. 1842.

[2] Medical Examiner, No. 2, 1842.

Josse, of Amiens, in 1845, operated on a boy aged 13, who several years before had met with a fracture of both bones of the leg, which had become consolidated with acute angular deformity so as to prevent all locomotion. A wedge-like piece of bone was removed, and a cure with a shortened but useful limb resulted.[1]

Mr. Rynd, of Dublin, gives an instance of a badly united fracture of both bones of the leg, in its lower third, in a man aged 28, of three years' standing, in which he sawed off the angular portions of the bones. The operation was done in July, and so severe were the symptoms that followed (hectic, profuse discharge, etc.), that in the month of September amputation of the limb was proposed to the patient, but refused, and, after struggling on, living on tonics, wine, porter, etc., a piece of the tibia was found to be necrosed in the month of October, and was removed. From this time he improved, and got well, with a perfectly straight and useful leg.

Another case of resection of the femur for an irregularly united fracture, followed by a successful result, has been made known by Dr. Dorsey, of Ohio, in the *Western Lancet* for May, 1848.

In a case occurring in a young man, in the middle of the femur, attended with much deformity, Dr. Crompton made a resection with success; firm union occurring in three months, and the limb straight and but slightly shortened.[2]

Dr. Brainard proposed and put in execution in 1858 a new method of treatment for irregularity of bones resulting from badly treated fractures. This consists in weakening the bone by subcutaneous perforation, and causing it to soften by the inflammation thus excited, and then straightening it by pressure. The case was in the leg, in a child aged three, and had existed for three months. The bone was perforated in two different directions, and the rupture attempted by laying the leg on a firm bed with the hands "by throwing nearly the whole weight of my body upon it." It did not, however, yield in the slightest degree. At the end of ten days, after the inflammation, which was considerable, had subsided, another attempt to straighten the leg was made and he was somewhat surprised to find that a very moderate degree of force, applied by the hands, was sufficient to cause the callus to give way. A bandage and curved splint were then applied for four weeks, at the end of which time the limb was straight. Three months afterwards the splint was thrown aside, and the cure complete.[1]

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[1] Malgaigne's Journ. de Chirurgie, 1845, p. 300.

[2] New Orleans Journ., vol. v., 1848–9.

The following cases, taken in connection with those quoted in a former part of this paper (p. 123), showing that ill effects, and even death, may follow the simple rupturing of the callus, put in a strong light the necessity for great care before advising a resort to the practice.

In 1850 Dr. Horner resected a part of the femur in a case of fracture, which had happened eighteen months previously, and had united, with deformity, the bone being bent angularly on its outer side and the limb shortened, and afterwards made use of powerful extension with pulleys to overcome the shortening, and place the fresh surfaces in contact. Mortification of the limb followed, which terminated in death on the fourth day.[2] In a case of angular deformity at the junction of the upper with the middle third of the femur, occasioning a shortening to the extent of four inches, Mr. Gay, of London, ruptured the callus about a twelvemonth after the accident. Finding, after this procedure, that it was impossible to place the fragments in a better position than they were before, he, after the lapse of a few days, resected the ends of the bone, and placed the limb on a splint. Ten weeks after resection, in consequence of exhaustion and serious constitutional disturbance, amputation was done, and the patient died while the vessels were being secured.[1] Another like case, where a fracture in the middle of the femur had united in such bad position that it was re-broken and no union took place, notwithstanding three different modes of operative relief were resorted to, occurred to Sir William Fergusson, and was amputated by him unsuccessfully.[2]

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[1] Amer. Journ. Med. Sci., April, 1859.

[2] Med. Examiner, Philadelphia, vol. vii., N. S., 1851.

After the cure of fractures, points of new bone are at times thrown out in such a way as either to give rise to much suffering, or prevent proper motion in the joints, and in these cases operative measures have been resorted to for their cure. Mr. Alcock[3] relates the case of a gentleman who, in 1835, was thrown from a gig, and fractured the upper third of the ulna into the elbow-joint. Considerable swelling supervened, and the fracture was not discovered until some union had taken place, and that at such an angle that a sharp peak projected at the posterior surface, rendering any attempt at flexion painful in the extreme, from the stretching of the skin over the sharp end of bone. Gentle passive motion and friction had been adopted, but the time had arrived, Mr. A. believed, when more force was required, and no perceptible advantage could be gained without it. This opinion was founded upon the diagnosis, that mere ligamentous bands, uniting the fragments at an angle, prevented the flexion of the arm, and that it required regulated but considerable force to elongate these, and, before it could be attempted, removal of the projecting sharp end of the bone was necessary. Sir A. Cooper concurring in this view of the case, the projecting end of the bone was removed, and, as soon as the wound was healed, a moderate degree of forcible extension was employed. The case rapidly improved, and he recovered the perfect use of the part.

A nearly similar operation was done with success, at the urgent request of the patient, upon a female at La Charité, by M. Velpeau,[4] and a like method is said to have been employed upon the femur in England, by Mr. Dawson, with happy result.

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[1] Lancet, vol. ii., 1850, p. 456.

[2] Lancet, vol. ii., 1850, p. 653.

[3] Medico-Chirurg. Transactions, vol. xxiii. p. 315.

[4] Méd. Opérat. 2ème ed., tom. ii. p. 559.

STATISTICS OF FRACTURES AND DISLOCATIONS TREATED IN THE PENNSYLVANIA HOSPITAL, DURING THE TWENTY YEARS FROM 1830 TO 1850.

DURING the twenty years from 1830 to 1850, a large number of fractures and dislocations were received at the Pennsylvania Hospital, and, without having any novelties regarding their treatment to make known, I have thought it would be of interest to present a statistical account of them, with the view of showing their relative frequency and the results obtained there during a long term of years.

In these tables no separate head is retained for compound fractures, except those of the thigh; the entries having been so made in the books of the hospital, that it was impossible when they were begun in all cases accurately to ascertain whether the patient was admitted for simple or compound fracture; and for the same reason, under the heads of fracture of the arm and fracture of the leg, are included respectively those of the forearm, either of one or both bones, as well as of the humerus, and of one or both bones of the leg. As has ever been the case, surgeons are still divided in opinion as to the best method of treating fractures of the extremities. Volume after volume has been written to show the propriety of one or another mode of treatment, but in few instances only has an appeal to a large number of facts been made to justify the recommendations that have been given of them. To public institutions it is, that we must principally look for statistical information in regard to these injuries, and, although our records on this subject are so imperfect as to give only general results, still we look upon them as of some interest, and have prefaced them with a concise account of the plan of treatment generally adopted in these accidents, *during the time mentioned.*

Femur.—In the treatment of most fractures of the thigh, the straight position was preferred, and the apparatus of Desault modified was that mostly employed. The improvement consists in the greater length of the outer splint, and the attachment to its lower end of a small block, over a notch in which the extending band passes, in order that the extension be made in a line with the axis of the limb. If the limb can be at once brought down to its natural length, it in all cases should be done on the first application of the apparatus; but, when there is so much muscular contraction as to render this very painful, the limb need not be drawn to its full length at first. In these cases it should be extended as much as possible, and, at the second visit of the surgeon, should be seized at the ankle, and slowly pulled downwards, while an assistant tightens and makes fast the extending band. This course is to be repeated until the fragments are perfectly reduced, which may in most cases be readily done at the end of twelve or eighteen hours. No great advantage is believed to be gained by the employment of short splints, or bandages of any sort, applied immediately to the thigh, and their use is dispensed with, as they prevent the surgeon from accurately examining the state ot the fracture, and require that the limb should be disturbed in order to reapply them. A long narrow bag, stuffed pretty firmly with cotton, and covered with buckskin, is used for the counter-extending band; and a double buckskin gaiter, with a thin layer of carded cotton laid over it, or a buckskin band lined with linen, is made use of for the extension.[1] Extension violent enough to cause pain should never be made use of; it ought always to be moderate, steady, and permanent. If constant pain is complained of at any point on which the dressings press, it should be immediately examined and readjusted. The restlessness of patients causes any apparatus to be easily displaced, and it is therefore necessary to smooth, tighten, and carefully re-examine it daily. Excoriation of the heel is most frequently produced by want of care in not having the extending band smoothly applied to the part, or by tightening it in too great a degree without having previously drawn down the limb with the hand. Sometimes, however, excoriation is caused by the weight of the foot alone; and in these cases the application of a piece of kid, spread with soap cerate, will mostly prevent it.

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[1] Since the period included in these tables bands of adhesive plaster reaching from just below the knee to two inches below the plantar surface of the foot, and there fastened to a thin piece of board two inches square, have been introduced, and form an admirable method of extension. To prevent slipping, the longitudinal bands are confined by two or three adhesive strips encircling the leg. If the cord running from this be conducted over a pulley fixed at the foot of the bed and attached to a weight, or a bag partially filled with shot, we have a uniform and constantly acting extension; and when this form of apparatus is adopted sand-bags placed at the sides of the limb (extending from the hip to beyond the foot) are a simple and efficient mode of replacing the apparatus of Desault; or, if preferred, the same method of extension can be employed with the last-named method.

In fractures of the femur within the capsular ligament, the application of any splints in the treatment is discarded—the limbs being merely supported by pillows in the extended position. No case has been observed in the period comprised in this report, in which the toes were thrown inwards. Several instances of fractures about the hip-joint, in persons of middle age, have come under notice, in which, even with the most accurate examination and measurement, it was impossible to detect any crepitus or shortening of the limb till after the lapse of one or more days.

Although the signs by which fractures of the neck of the thigh-bone and luxations may be distinguished from each other, and from simple contusions, are dwelt upon in our treatises, and are made out to be readily distinguishable, and well marked, yet all practical surgeons are aware of the difficulties of diagnosis sometimes attendant upon the various injuries about the hip upon actual inspection. The true nature of the injury in these cases is often more evident some time after the receipt of the accident than immediately upon its occurrence, and I am inclined to think that the necessity of close *secondary* examinations, in all instances in which there is room for a doubt as to the nature of the injury, are not sufficiently insisted on. The following cases, which came under notice, are well calculated to show the necessity of close and repeated examinations in injuries of this part.

John Henrick, aged 52, was admitted November 27th, 1831, for an injury of the hip received by falling down a few steps. He complained of excessive pain about the joint, and was unable to rise, or in any way move the limb. Accurate measurement from the anterior superior spinous process to the malleolus showed the limb to be of the same length as that of the opposite side. No deformity existed about the joint, no crepitus could be detected, and the toes were not thrown outwards. The injury was looked upon as a contusion, and rest and the application of a few cups were the remedies prescribed.

On the fifth day after his admission he had an attack of mania-à-potu, and during his delirium was out of bed, stood upon and moved his limb considerably. Having recovered from this attack, he was sent back, from the room to which he had been removed, to the surgical ward, and it was then found that the limb was shortened a full inch and a half, and the knee and toes everted, though a daily examination of the part up to the time of this attack showed nothing amiss about it. The case now was ascertained to be a fracture through the great trochanter.

In January, 1831, another case, very similar to the above, occurred in a patient aged 38. When admitted, he complained of great pain in the hip, but the toes were not everted; no crepitus could be detected, and upon careful measurement no shortening of the limb was observable. A short time after his entrance, he also was attacked with mania-à-potu, and on recovery shortening was discovered. Long splints were applied, with the effect of counteracting in a measure the shortening, and the man left the hospital in April, walking with a stick.

The exact length of the limb on entrance, with the natural position of the foot, and absence of any deformity or crepitus, led to the supposition, in both the above cases, despite the great pain suffered, that simple contusions only of the part existed, and this idea was confirmed at the commencement of the attacks of their delirium, upon seeing the men up and moving about the room; but, after recovery from their delirium, the eversion of the foot led to an immediate examination, when the shortening was found to exist, which, in connection with the symptom just mentioned, could only be caused by fracture of the neck of the bone. In both cases the fragments must have been interlocked in such a way as to have prevented any shortening or motion, and so remained till the delirium occurred, when the violent efforts made to use the limb unlocked the parts, and permitted the lower fragment to be drawn upwards.

Previously to witnessing these cases I had believed it impossible for a patient with fracture of the neck of the femur to walk upon the limb, but, upon examining the records of our science upon this point, I find that similar instances are noted. Sabatier[1] has recorded an instance in which the patient walked home, and even got up the next morning, after an injury of this kind. Desault has seen similar cases.[2] Boyer states that he saw a man who was able to walk with the aid of a stick during several days after a like accident;[3] and Dr. McTyer[4] details a case which had not confined the patient from her usual occupations, but which was proved on dissection, three months after, to be a case of fracture within the capsular ligament.

Since the occurrence of the cases I have described, Mr. Syme[5] and M. Malle, in his *Clinique Chirurgicale*, have each given a case of fractured neck of the thigh, in which the patients walked some distance after it. Dr. Hunt details one of intra-capsular fracture of the femur in a young man, where he walked several hundred yards after the accident. He died subsequently from pelvic abscess and pyæmia, the result of the severe contusion received at the time of the accident, and the autopsy verified the diagnosis.[6] I have myself seen another hospital patient, with a similar fracture (proved by post-mortem examination), who assured me that he had walked some squares after the occurrence of his accident.

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[1] Mémoires de l'Acad. de Chirurg., tom. iv. 8vo.

[2] Œuvres Chirurgicales, tom. i.

[3] Mal. Chirurgicales, 4ème édit., tom. iii.

[4] Glasgow Med. Journ., vol. iv.

[5] Edin. Med. and Surg. Journ. for 1836.

[6] Loc. citat.

Leg.—In the treatment of fractures of the leg, as in those of the thigh, splints or bandages are rarely applied to the limb. The leg is placed in a fracture-box upon a well-stuffed pillow, in such a manner as to bring the sole of the foot in contact with the foot-board. The fractured bones are then accurately adjusted, and the sides of the box are tied together moderately tight. The foot is securely fastened to the foot-board by means of a strip of bandage, in order to prevent its falling to either side, and the pressure of the pillow is, in the vast majority of cases, quite sufficient to retain the fragments in their natural position. The foot-board of the box is set into its bottom nearly straight, and is made to project beyond the foot, in order to prevent the toes from falling downwards, and thus cause a projection forwards of the upper end of the lower fragment.

Severe inflammation so frequently follows these fractures, in consequence of most of them being accompanied with much contusion, that measures are invariably taken *ab initio* to lessen its severity. These consist in the application of cooling lotions to the limb and attention to position, elevating the fracture-box or foot of the bedstead. When evaporating lotions are employed, oiled or rubber cloth should be placed upon the pillow to prevent its becoming wet and unpleasant. In order to obviate deformity in these fractures when they occur at the lower part of the leg, it is highly important to keep the foot well forwards, and this is best done by placing under the head some layers of carded cotton.

At the end of five or six weeks, the union is generally sufficiently firm to allow of the removal of the limb from the box, and a bandage and pasteboard splints, made to fit accurately the leg by previously soaking them in warm water, are applied to its sides. On these becoming hard, the patient is permitted to move about.

In very oblique fractures of the leg, where the pressure made by the pillow is not sufficient to prevent the recurrence of deformity after its reduction, permanent extension is kept up by means of Desault's splints, as in fractures of the thigh.

In fractures of the lower end of the fibula, where the foot is much drawn outwards, the apparatus of Dupuytren, consisting of a conical pad to make pressure over the internal malleolus, and a single splint applied to the inside of the limb, from the upper extremity of the leg to some distance beyond the foot, is employed; but where, as is most generally the case, the tendency to a recurrence of the deformity is not in a great degree, the apparatus commonly made use of for other fractures of the leg, consisting of the fracture-box and pillow, so placed as to exert rather more pressure than usual upon the outer ankle, is resorted to. These fractures are sometimes accompanied by compound luxation of the lower end of the tibia. The following instance in which this occurred, where the lower extremity of the tibia was successfully removed by Dr. Harris, was witnessed by me.

Barney Short, ætat. 32, was admitted on the 21st of June, 1830, for a compound fracture at the ankle. Upon examination, the foot was found to be thrown outwards, and the end of the tibia to protrude through the integuments, which embraced it tightly, at the same time that there was a fracture of the fibula three inches above the joint.

Pretty strong efforts were made to reduce the displaced bone, which caused the man so much pain, that Dr. H. desisted from his attempts, and determined to saw off the projecting end of the tibia.

About an inch and a half was accordingly removed, after which the bones were easily reduced and the limb placed in a fracture-box and cold applications made to it. Although severe inflammation followed the operation, yet the man did well, and was discharged on the 13th of October following, walking with the aid of a crutch, but with the wound perfectly healed.

Two years after, Short visited the hospital; his leg was perfectly sound, though of course shortened. With a high-heeled shoe he walked very well and a great deal—his occupation being at the time that of a peddler.

Patella.—In fractures of this bone, the treatment consists in the application of a roller from the toes upwards, passed around the knee in such a way as to bring the fragments into apposition, and applied with a very moderate degree of tightness. The limb is then extended upon a well-padded splint, extending from a little above the heel to the upper part of the thigh, and the whole is afterwards placed upon an inclined plane composed usually of pillows.

Clavicle.—For a number of years past, the use of Desault's apparatus for fracture of the clavicle has been entirely abandoned. As generally put on, the apparatus does not fulfil the indications intended, and when applied tightly and properly, so as to keep the fragments in perfect apposition, it in most cases produces great difficulty of respiration, or severe pain in the arm or chest. Besides this, it soon becomes relaxed, is easily deranged, and covers entirely the seat of injury, thereby making it impossible to ascertain whether or not the reduction remains complete without the removal of a part of it. The apparatus used at the hospital consists in a pad for the axilla, a ring formed of some soft substance, as a roll of muslin or of buckskin, for the shoulder of the sound side, and a sling for the elbow made of linen, extending half way up the arm, and two-thirds of the way down the forearm. To the elbow-piece are attached three strong tapes—one to its upper and posterior part, and one to each anterior extremity. The following is the mode of applying the apparatus: a proper pad being selected and fixed in the axilla, by means of tapes fastened to its upper ends, and passing over to the sound shoulder, the ring or collar is carried up and held on the shoulder of the sound side; the sling is then fitted to the elbow, and after the fracture is reduced by drawing the arm downwards, and pushing the elbow upwards across the chest, the tape on its posterior part is carried over the back and firmly tied to the collar on the opposite side. This done, the surgeon comes round in front of the patient, and makes fast to the collar the tapes attached to the anterior extremity of the elbow-piece. These are to be drawn tight enough to throw the shoulder sufficiently outwards and upwards to remove all deformity. The hand is then supported in a sling, or by a strip of bandage fastened to the collar. The whole apparatus is to be re examined and tightened daily. The chief indications in the treatment of fracture of the clavicle are perfectly fulfilled by the use of this apparatus; the pad in the axilla throws the shoulder outwards, at the same time that the drawing up of the elbow by the linen bag throws it upwards and backwards. Besides this it is simple, requires no bandaging, and leaves the part injured at all times open to inspection. The apparatus, too, can readily be applied in females, in whom it is all important to obviate deformity. The apparatus was contrived and introduced into the practice of the hospital in 1828, by Dr. Fox, then house-surgeon, since which time it has been constantly employed.

Spine.—The treatment in these cases consists in keeping the patient in a state of perfect rest, at the same time that pressure is taken off the projecting parts as much as possible by the application of pillows and other appropriate means, in the careful use of the catheter, and in obviating any symptoms of inflammation that may set in by the usual treatment. No instance has occurred in the twenty years in which the operation for raising depressed portions of the vertebræ has been practised.

Humerus.—In fractures situated at the middle of the bone, three or four pasteboard splints are commonly made use of—the outer extending from the top of the shoulder to the external condyle, the inner reaching from the axilla to just above the internal condyle, and the anterior one sufficiently long to reach to the bend of the arm. The roller is applied, as in all other cases, from the fingers up, and the fracture being reduced, and the splints fixed as mentioned, is returned and fastened over them. The arm may then be bound to the body by a broad bandage, or can be left free, supported by a sling. In patients who are very restless, the roller soon becomes loose about the forearm and elbow, and necessitates a frequent reapplication of it. To prevent, in a measure, this almost daily renewal, the use of an angular board splint well padded, and extending from the axilla to the hand on the inside of the arm, is sometimes substituted; one or more short splints being at the same time applied above the elbow. The fragments by this means are held perfectly in place, and the angular splint, by holding the forearm at rest, keeps the bandage well and evenly applied for a much longer period than is otherwise possible. During the cure, the angle of the splint should be occasionally changed, in order to prevent any degree of stiffness at the elbow. This mode of dressing is applicable to fractures below the insertion of the deltoid only; for fractures situated high up in the bone it would be manifestly improper.

Elbow.—One of the most common of these, after fractures of the inner condyle, is that in which two fractures and three fragments are present, the humerus being broken transversely just above the condyles, and these last separated longitudinally. All fractures about this part are very troublesome and serious accidents, and to treat them well requires extraordinary care and attention, whatever method of treatment may be made choice of. Two rectangular splints applied to the inner and outer sides of the arm, and extending from its upper part to the ends of the fingers, are frequently employed with us. When these are used, the angles of the splints should be frequently changed to prevent deformity and stiffness of the joint—those first applied being removed after ten or twelve days, and replaced by others of an obtuse angle. Another method of treatment, which is sometimes pursued at our hospital in fractures about this joint with very satisfactory results, consists in the application of a single board splint applied to the front of the arm. This should be of the width and shape of the limb, well padded, and extending from the upper part of the arm to the ends of the fingers. At first a right angled splint may be used, but at every dressing (and after the first few days they should be frequent) it is to be changed for a more obtuse angled one, until finally the arm can be brought perfectly straight. The obtuse angled splints are then recommenced with, and gradually replaced by, others less obtuse, until the limb is again brought to a right angle. This plan, carefully pursued, will generally prevent deformity, at the same time that it is of more easy application, and more effectually hinders the occurrence of anchylosis than the common mode of dressing. The hinged splint, in which the angle is regulated at will by a screw, is also occasionally employed for similar purposes.

Forearm.—These accidents are treated by means of a roller and two splints, applied in the usual manner. Fractures of the lower end of the radius, which, it may be remarked, are very frequently mistaken for simple sprains, are treated also with two splints; the inside one extending from the upper part of the arm beyond the ends of the fingers, while that on the outside passes below the knuckles. In these, as in all other cases in which a simple fracture communicates with, or is in the immediate neighborhood of, the wrist or elbow-joints, the dressings should be removed at the end of ten or twelve days, and, after the joint is gently exercised, are to be reapplied. This should be repeated, at furthest, every second day. The same rule should be observed in all cases in which the forearm is confined in two long splints, as otherwise great rigidity of the wrist-joint occurs, which is annoying to the patient, and requires a very long time for its disappearance.[1]

Ribs.—Fractures of the ribs are treated by the application of a broad roller to the chest, confining the patient to bed, and the usual general treatment, such as abstraction of blood, etc., when dyspnœa, pain, or other untoward symptoms arise. A large pitch plaster is sometimes used with advantage.

Cranium.—In cases of simple fractures of the cranium with depression of bone, but unaccompanied with symptoms of compressed brain, the trephine has not been resorted to, while, in instances of compound fracture, attended with depressed fragments, even where no symptoms of compression existed, it has been the general practice to remove the portions driven in.

No separate head is retained for compound fractures of the leg or arm, the entries being so made in the books of the institution that it is impossible in all cases accurately to ascertain whether the patient was admitted for simple or compound fracture, and for the same reason under the heads of fracture of the arm and fracture of the leg, are included, respectively, those of the forearm, either of one or both bones, as well as of the humerus, and one or both bones of the leg. It is to be regretted that no record of the period required for the union of the different fractures treated has been kept. In all cases except a very few where our patients request a discharge, it is the custom of the house to retain them for a considerable time after union—until the stiffness and debility resulting from their injuries and confinement have been so far removed as to enable the patients shortly afterwards to resume their employments.

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[1] In later years, Bond's splint, in which the forearm is supported by a board applied to its inner surface, while the hand is made so to clasp a block as slightly to evert it, has been used very successfully.

The number of fractures treated during the twenty years from 1830 to 1850 was 2208, and their relative frequency will be seen in the following table.

	Number.	Cured.	Relieved or removed by friends.	Died.
Fractured thigh	266	217	17	32
Fractured leg	611	490	29	92
Fractured cranium	110	32	11	67
Fractured patella	42	38	3	1
Fractured spine	25	1	4	20
Fractured sternum	6	4	1	1
Fractured clavicle	188	165	20	3
Fractured arm	579	506	48	25
Fractured fingers	69	61	7	1
Fractured scapula	28	21	5	2
Fractured elbow	2	1	..	1
Fractured nose and face	23	16	4	3
Fractured jaw	51	33	10	8
Fractured pelvis	13	9	..	4
Fractured feet and toes	50	34	6	10
Fractured ribs	88	72	8	8
Fractured astragalus	1	1	..	..
Fracture	3	3	..	..
Compound fracture pelvis	1	..	..	1
Compound fracture knee	3	2	..	1
Compound fracture thigh	30	8	1	21
Fractured os calcis	1	1	..	..
	2190	1715	174	301
Ununited fractures	18	11	5	2
	2208	1726	179	303

No instance of artificial joint followed the treatment for fracture during the twenty years included in the report, all the cases observed there during that period having been sent to the institution from distant parts. Of the eighteen cases that were received, twelve were cured, two died, one was benefited, and four left the house a short time after entrance without undergoing any treatment for it. Of the fractures included in the above table, many were compound, and many complicated by other serious injuries.

DISLOCATIONS.—With the exception of a few of the luxations of the shoulder and hip, the cases included in the table at page 147 were of recent occurrence, and in all of these the bones were reduced without accident of any sort. Two out of the four luxated shoulders marked as discharged by request, were incurable. One of them existed in the person of a young sailor, aged 20, who was admitted December 4, 1830, with a forward dislocation of the head of the humerus of sixty-two days' standing. Some days after his entrance, an attempt was made by Dr. Hewson to reduce it by means of the pulleys. Great force was used, and the efforts were kept up for a long time, but without success. After the lapse of a short time, by request of the patient, strong efforts were again made to reduce it, and kept up for a considerable time, but with no better effect than on the first attempt.

The other case was a forward luxation of three months' standing, which it was found impossible to reduce by any proper degree of force.

Among the cases of dislocation of the shoulder cured, are those which had been out twenty-six, forty-five, fifty-three, thirty-one, ten, twenty-one, thirty-one, seventy, thirty-four, forty-eight, thirty-one, two of twenty-nine, ten, and four days respectively. One of the recent dislocations was accompanied by a compound fracture of the elbow of the same side, of so severe a character that amputation in the middle of the arm was performed, the luxation being reduced previous to the operation.

Of 49 dislocated shoulders in which the direction of the displacement is noticed, 39 were into the axilla, and in 10 the head of the bone was found under the clavicle.

In one of the luxations, the reduction was followed by inflammation and suppuration about the joint. The patient was a stout countryman, aged 25, from Carlisle, and had been injured forty-eight days previous to his applying for relief. The dislocation was into the axilla. On the 21st of December, 1840, the pulleys were applied, and extension was made gradually and moderately for fifty-five minutes, previous to and during which time a solution of tartar emetic was given, and a large bleeding resorted to. At the end of the period mentioned, the head of the bone was returned to its socket, all deformity disappearing. Two days after the reduction he was attacked with inflammation around the orifice made by venesection, which went on to suppuration, and an opening for the evacuation of the pus was made on the 28th. The shoulder of the dislocated side, which had become swelled and hot soon after the reduction, despite the employment of the usual means for allaying inflammation, presented on the 30th more swelling, and a sensation of deeply-seated pus. On the 31st, the fluctuation was more distinct and an opening was now made, giving issue to a quantity of healthy pus. After the opening of the abscess, the discharge continued till towards the middle of February, during which time he suffered from an attack of erysipelas, then prevalent in the hospital. After this period, the discharge gradually lessened in quantity and became thinner. Early in March, an abscess formed at the posterior part of the axilla, which was opened and discharged freely. By the beginning of April, the abscess had closed, and all heat and swelling had left the part. On the 26th of the same month he returned home, the head of the bone being in the socket, though the parts about the shoulder were still much hardened and stiff.

In another case, which I failed to reduce, the head of the bone was in the axilla, and was of ten weeks' standing. The patient was fifty years of age, and was admitted into the hospital June 11th, 1840. He stated the accident to have been produced by a fall; that some efforts were made to replace the bone immediately after its occurrence by an unprofessional person, and that a week before his entrance well-directed and long-continued efforts were made by a surgeon to reduce it. He was a blacksmith by trade, and, being anxious for a further trial to reduce it, had entered the hospital for that purpose. All the symptoms of luxation downwards were well marked. The head of the bone was high up in the axilla, and admitted of very little motion. The dangers to which he would be exposed by efforts at reduction having been first plainly stated to him, the pulleys were applied, and extension and counter-extension, to as great a degree as was judged safe, kept up for nearly an hour, at the same time that the muscular system was relaxed by bleeding and tartar emetic. At the expiration of this time, as the head of the bone had not yielded in any degree to the force employed, further efforts were desisted from, and he left the house.

The subject of the reduction of dislocations of long standing is one of considerable interest. The class of cases and the periods after the injury, in which attempts may be undertaken with any prospect of success, as well as the accidents that sometimes follow them, have not as yet received that attention which they merit. In the first of the above cases, where the patient was young and robust, and the arm admitted of some motion, the reduction was accomplished seven weeks after the accident, by the employment of a less degree and shorter continuance of extensive force than I have repeatedly made use of, but was followed by inflammation and suppuration about the joint. This accident does not very often occur after attempts at replacement of luxated bones, though cases have been observed in which it has followed the easy reduction of even recent dislocations. In the last case, where the injury was of ten weeks' duration, and the patient somewhat advanced in life, with the head of the bone drawn high into the axilla, we were foiled in our attempts to reduce it, and understood that the patient subsequently submitted to a third pulling, under the direction of a gentleman of this city, after previous division of some of the muscles or tendons about the joint, without better success.

I am well aware that surgeons have always examined into the degree of motion existing in an unreduced joint before determining upon the propriety of an attempt at reduction, in cases where bones have been long out; but, nevertheless, am disposed to think that we have been accustomed to direct our attention too much to the time which has elapsed since the receipt of the injury only, without allowing the situation of the bone, and the degree of motion, due weight in determining the question. Abundant evidence might be adduced to show that luxations have often been reduced after the limits fixed upon by our best authorities, where the head of the bone admits of slight movements, and is not drawn up closely into the axilla, and where an opposite state exists they are frequently irreducible long before that limit is arrived at.

General Summary of the Dislocations treated during twenty years, from 1830 *to* 1850.

	Number.	Cured.	Relieved or removed by friends.	Died.
Dislocated shoulder	101	96	4	1
Dislocated hip	21	17	3	1
Dislocated astragalus	3	1	..	2
Dislocated cervical vertebræ	1	..	..	1
Dislocated jaw	2	2	..	..
Dislocated ankle	2	1	..	1
Dislocated elbow	16	16	..	..
Dislocated wrist	4	4	..	..
Dislocated clavicle	12	9	3	..
Dislocated radius	2	2	..	..
Dislocated great toe	1	1	..	..
Incomplete dislocation of knee	1	1	..	..
Dislocated semilunar cartilage	1	1	..	..
Dislocation and fracture	1	1	..	..
Dislocation and lacerations	1	..	..	1
Dislocation	1	..	1	..
Compound dislocation of fingers	2	2	..	..
Compound dislocation of thumb	5	3	..	2
Total.	177	157	11	9

A case of dislocation with fracture of the astragalus is included in these tables. It was that of Samuel Dobbins, aged 15, who was admitted July 20th, 1846, with injuries received by being caught in the machinery of a mill. Two wounds existed on the scalp, he was much contused about the body, and the left ankle was severely contused, though the skin was not broken, and there was a rounded projection behind the external malleolus, with the foot in the natural position. He was but partially sensible when admitted, and was feeble, with a cool surface. He slowly reacted and became sensible, and by the following day the ankle had become much swollen. The limb was placed in an easy position on a pillow in an elevated fracture-box, and cooling applications made to it.

On the 24th, though the swelling continued, he complained of no pain in it, and a careful examination proved that the projection on the outer side of the foot was a portion of the astragalus which had been broken off and thrown from its socket. It could not be returned by moderate efforts.

On the 31st a slight discoloration of the skin over and around the malleolus was observed. On the 5th of August fluctuation was distinctly felt, and pus of an unhealthy character was discharged by an opening made for that purpose. By the 9th the discharge had become more healthy, and the swelling had abated; but the youth was exceedingly feeble. A nutritious diet, tonics, and porter were allowed.

No great change took place till the 28th, when sloughing occurred about the injury, and erysipelas soon followed, extending up to the knee. Previous to this, the displaced piece of the astragalus was immovably fixed, but after the inflammation subsided it became movable, and was so loose by the 3d of September that it was removed. Upon examination, it proved to be that portion of the astragalus which articulates with the tibia. A large abscess afterwards formed about the middle of the leg which was opened and soon filled up; the wound made by the opening and sloughing over the bone closed rapidly, and on the 3d of October he left the hospital, walking with a cane and with considerable motion at the ankle.

A case of a similar kind was witnessed by me in 1831, when a resident of the institution. It was that of William Summerill, ostler, aged 30, who was admitted on the 26th of September, and came under my immediate care under the direction of Dr. J. R. Barton.

An hour previous to admission, while descending a ladder, he slipped and fell in such a manner as to throw the entire weight of his body upon the outer part of his left foot. Upon examination the foot was found to be turned inwards, and nearly immovable. A slight depression existed immediately below the lower end of the tibia, and there was a considerable hard and rounded projection on the outer part of the foot, a little below and in front of the extremity of the fibula. The skin covering this projection was reddened, but not excoriated. There was no fracture of either bone of the leg.

These appearances rendered it evident that the injury was a dislocation outwards and forwards of the astragalus; and a short time after admission efforts were made by Dr. Barton to reduce it. This was done, after relaxing in as great a degree as possible the muscles of the leg, by fixing the knee and having assistants to keep up extension by seizing the heel and front part of the foot at the same time that the bone was pushed inwards and towards the joint by the surgeon; these efforts were continued for a considerable time, but had no effect in changing the position of the bone.

Six hours afterwards, in consultation, attempts were again made at reduction, which, not proving more effectual than on the first trial, the excision of the displaced bone was determined on.

The patient being properly placed, an incision was made through the integuments, parallel with the tendons, commencing a short distance above the projection on the foot, and extending down far enough to expose fairly the astragalus and its torn ligament; the bone was then seized with forceps and easily removed after the division of a few ligamentous fibres that continued to connect it to the adjoining parts. Very little hemorrhage occurred; two small vessels only requiring ligature.

After removal it was discovered that about one-half of the surface which plays in the lower end of the tibia, had been fractured, and remained firmly attached to the extremity of that bone, and, as it was judged that the efforts necessary to remove this would be likely to produce more injury to the joint than could arise from allowing it to remain, no attempt was made to extract it.

The joint being carefully sponged out, the sides of the incision were brought accurately together by means of a suture and adhesive strips, after which, simple dressings and a roller were applied, and the foot, restored to its natural position, was placed in a fracture-box.

Sept. 27*th.* Had a restless night, having suffered from pain in the joint. Pulse good; skin moist; no thirst; has now but little pain; has taken opium freely since the operation, which is to be continued. Low diet.

28*th.* Passed a good night; is without fever; no pain in the foot, which lies comfortably in the fracture-box: dressings are moistened by oozing from the wound, but have not been disturbed; bowels confined. Common enema; opium continued; soup.

29*th.* Does not complain of limb; rested well; general symptoms good; dressings removed; no union; wound suppurating freely. Opium continued; soft poultice to the part.

October 1*st.* Yesterday (30th) a portion of the skin on the outer part of the foot was red, and tender to the touch, and to-day a small slough, about an inch in diameter, occupies that part; wound, nevertheless, looks well, though the suppuration is more free. Same treatment continued.

5*th.* Since last report the discharge has been gradually augmenting, and is now profuse. Slough did not increase in size, and was not deep; bowels regular; pulse more frequent and feeble; tongue clean; night sweats. Good diet, with porter; opium and poultice continued.

8*th.* Both ligatures came away; suppuration continues free; a collection of pus has formed near the internal malleolus, for the free discharge of which a counter-opening was made; heavy sweats at night; no diarrhœa; appetite failing. Sol. sulph. quinine; morphia at night.

By the 15th the discharge of pus had greatly lessened, and his general symptoms had improved.

December 12*th.* To-day that portion of the astragalus which had been suffered to remain attached to the tibia was found to be carious and loose, and was removed. Constant pressure on the heel has produced ulceration of it. The limb is much swollen; wound has made but little progress towards cicatrization; granulations are exuberant and of a light color; secretion of pus still great; general symptoms good. A probe introduced through either opening into the joint, shows the surfaces of the adjoining bones to be rough, softened, and evidently carious.

March, 1833. Since the last report (a period of fifteen months), various means have been resorted to for the removal of the carious portions of bone and cicatrization of the wound, but unsuccessfully. At this time the bones of the foot and ends of the tibia and fibula are all diseased. The patient's general health has suffered severely from the long-continued irritation. He has well-marked hectic fever, accompanied by heavy night sweats; he has also frequent attacks of erysipelas in the limb, and diarrhœa. Amputation of the leg was now looked upon as the only means of saving his life, and was accordingly done on the 27th by Dr. Barton.

The circular operation was performed, and union by the first intention attempted. The stump never took on a good appearance, showing no disposition to unite, and discharging a thin fetid matter. His diarrhœa returned a few days after the performance of the amputation; his strength failed, and he died on the 5th of April.

Examination of the amputated limb showed that no attempt at regeneration had been made in the joint; the bones of the tarsus and ends of the tibia and fibula were in a great measure deprived of their cartilages, and so much softened, as to be readily cut into with a scalpel. The tarsal ends of the metatarsal bones were also softened, and the tibia was spongy in its whole extent, and remarkably light.

The records of our science possess but few cases of luxation of the astragalus, not complicated with laceration of the integuments; and an examination of those reported show that surgeons are at variance in regard to the best mode of treatment of them. All agree that efforts should at first be made to restore the displaced bone; but this failing, as in the majority of instances it does, where the luxation is complete, what course is to be pursued? Is the bone to be suffered to remain in its new situation, or is it to be removed? If permitted to remain, violent inflammation of the integuments and joint is almost certain to follow, in which event there is great danger, from the state of tension the parts are placed in, of gangrene occurring and necessitating the amputation of the limb if not endangering the life of the patient; and even should the dangers of inflammation and gangrene be escaped, and a natural cure take place, great deformity and lameness must necessarily ensue, and the patient will remain more or less liable to ulceration of the skin over the projection on the outer part of the foot. For these reasons we deem the practice pursued by Summerill, of excising the astragalus, where the case is uncomplicated by other serious injury, far preferable to leaving the cure to nature; and the limb cured by the removal of the bone, though shortened and anchylosed, will be found both more useful and sightly than the club-foot deformity left after a natural cure.

Desault[1] reports two cases of this accident; one he reduced without difficulty, and the other he succeeded in replacing after enlarging the wound of the capsule. Boyer[2] details one case where the bone was left undisturbed; on the 18th day inflammation came on, and terminated in gangrene, when the limb was amputated with success. Mr. Gooch[3] relates a case of an irreducible luxation of this bone, in which he deemed it proper to amputate the limb. Sir A. Cooper[4] gives two cases, both irreducible. The first was attended with fracture of the tibia at the internal malleolus, and was left to nature; "the integuments sloughed, and the wound was a long time in healing." The second case was attended with a fracture of the fibula a little above the joint, and was also left to nature; the skin sloughed on the 22d day and exposed the astragalus. After four weeks the bone became loose and was removed, and at the end of five months the patient recovered.

In September, 1833, I saw a case treated by M. Dupuytren at the Hôtel Dieu of Paris. Two fruitless efforts were made at reduction, but he succeeded in bringing the foot nearly into its natural position. Six weeks afterwards the patient could use his limb. A small slough formed over the tumor some time after the accident, but separated without opening the joint. This case has been published in the 13th volume of the *Journal Hebdomadaire*, where mention is made of two other cases treated by the same surgeon. In one of these the bone was easily reduced; and, failing in the other, he proposed its extirpation. This was rejected by the patient, who ever after moved about with "pain and difficulty," the foot being greatly turned inwards. In the *Archives Générales* for December, 1833, a fourth case of the same surgeon is alluded to that was left to nature; gangrene followed, and the man was cured by amputation of the leg. In the same journal a case of Professor Nanula of Naples is given, where the practice pursued by Desault of enlarging the wound in the capsule was followed, and the patient recovered with a good limb.

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[1] Œuvres Chirurgicales, tom. i.

[2] Malad. Chirurgic., tom. iv.

[3] Surgical Works of B. Gooch.

[4] On Dislocations.

Dr. J. R. Barton informed me that he had seen two examples of simple dislocation of the astragalus at the Pennsylvania Hospital. One of these was in 1816, and being irreducible, was not interfered with. Inflammation came on after a short time, when the integuments sloughed and part of the astragalus was exposed; this, however, was soon covered by healthy granulations, and cicatrized. At the end of five months the patient walked and had good use of the joint, though great deformity of the foot existed, and he continued to be subject to ulceration of the newly formed skin on its outer part. In the other case, the care of which was also left to nature, gangrene took place soon after the accident, and the man died.

Compound, though more frequent than simple, dislocations of the astragalus, are nevertheless sufficiently rare to make their notice a matter of some interest. Formerly they were thought to require immediate amputation, but a sufficient number of observations is now collected conclusively to prove that the limb may be saved, though it has generally been thought necessary to remove the bone. Indeed, in the majority of these cases, this is so much detached from the adjacent parts as to be unable to support its vitality, and will, if returned, produce all the bad effects of a foreign body introduced into a joint.

In asserting that compound are more frequent than simple luxations of the astragalus, I am well aware that it is contrary to the opinion expressed by our highest authority, Sir Astley Cooper. At page 327 of his great work, he says, "A simple dislocation of the astragalus sometimes, though rarely, occurs; a compound luxation is much more rare." The grounds for this opinion, which is likewise that of most surgeons, are not stated; but that it was not the result of his own experience, is shown by his reporting five cases of the accident attended with more or less laceration of the integuments, while he gives but two of its simple displacement. A comparatively large number of examples of the compound dislocation of this bone may be found scattered through surgical writings. Hildanus,[1] the first author who speaks with precision of these luxations, gives an instance in which it occurred and the patient recovered after the extirpation of the bone. Boyer[2] cites five cases, all terminating successfully. Desault[3] and Hey[4] each report three examples of the accident, in all but one of which a cure had taken place. Sir A. Cooper, as just stated, mentions five cases occurring either in his own practice or that of his friends; in one of these the limb was amputated, and in another the bone was reduced, and all terminated successfully. M. Fallot[5] has given a case attended with fracture of the surfaces articulating with the scaphoid and calcaneum, in which excision was performed with success. MM. Arnal and Velpeau[6] have recorded each a case terminating fatally; one fifty-two and the other four days after its removal.

In our own country several examples of the accident have been observed. The late Professor Wistar removed the astragalus in a case of compound dislocation, and the patient was cured with some motion at the joint. Drs. Stevens[7] and

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[1] Opera. Cent. ii., obs. 67.

[2] Maladies Chirurg., tom. iv.

[3] Œuvres Chirurgicales, tom. i.

[4] Practical Observations.

[5] Journal des Progrès, tom. i.

[6] Journ. Hebdomadaire, tomes i. and xiii.

[7] N. Y. Med. and Phys. Journal, No. 20.

Gillespie[1] have recorded instances where the same practice was adopted with happy results; and Dr. Beatty has given an interesting case in which a cure followed, though the bone was preserved.[2]

I have seen, at the Pennsylvania Hospital, a case where the astragalus was thrown completely out from the limb; the following brief statement of which is taken from the note-book of my deceased friend, Dr. Hammersley, at that time one of the resident physicians.

The patient, Isaac Lyon, ætat. 22, was admitted on the afternoon of July 20th, 1829. He was of intemperate habits, and had received his injury a short time previous to being brought to the hospital, by the falling of a pile of boards upon his leg. The ankle-joint was laid open obliquely on its outer side for about four inches, and the external malleolus exposed. A bone that had been picked out of the soft earth upon which he had been lying, was handed to the doctor by a person who accompanied him, and proved to be the astragalus, with one of its edges broken off. There was no hemorrhage from vessels of any size, there being only a general oozing from the part, and no other injury was received. The attending surgeon, Dr. Barton, saw the case soon after admission, and directed the sides of the wound to be brought loosely together with adhesive strips, and the limb to be placed in a proper position in a fracture-box, with just pressure enough on its sides to steady it. The patient did not complain of much pain, but was kept under the influence of anodynes.

On the third day enormous swelling of the limb, and a crackling sensation upon pressure over the tibia existed; the whole leg and inside of the thigh were of a copper color, and some bloody vesicles had appeared around the ankle and upon the inside of the leg; countenance shrunken; pulse 140, and wound discharging a thin ill-conditioned pus. The treatment consisted in the free use of opium, stimuli, and nourishing soups; poultice to wound and lead-water to the limb.

On the morning of the fifth day he was unable to open his mouth freely, and his head was at times thrown back forcibly upon his pillow. These tetanic symptoms increased in violence, and towards night became general; and he lingered on in the greatest agony till the evening of the 27th.

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[1] Amer. Journal, Aug. 1833.

[2] Phila. Journ. of the Med. and Phys. Sciences, vol. v., N. S., 1827.

A case of *compound dislocation of the first upon the second phalanx of the thumb*, in which reduction was impossible until after resection of the head of the first phalanx, came under notice. The patient was a powerful drayman, aged 28, who, while engaged in unhitching his horse, had the end of his left thumb accidentally entangled in a link of the drawing chain, when the horse, starting suddenly, dragged him some distance and produced the accident. He was brought to the hospital late in the evening of February 17th, a couple of hours after its occurrence, when well-directed efforts were unsuccessfully made to reduce it, the clove hitch being attached to the extremity, after a failure with the hand alone. On the following morning, I found the head of the first phalanx protruding inwards through a wound which embraced more than one-half of the circumference of the finger; another effort at reduction was now attempted by bending the luxated bone and endeavoring to push its projecting head over that of the adjoining bone, but, failing in this, I determined to remove the protruding extremity, which was done and the parts then easily replaced. The edges of the wound were drawn together with narrow strips of adhesive plaster and the part covered with dry lint, the hand and forearm being secured upon a splint. After the third day, the dressings were daily made, the part being only covered with simple ointment. No unpleasant symptoms followed. He was discharged March 23d, and a month afterwards he called at the hospital, at which time he had good use of the thumb with some motion at the point of injury.

The difficulty of reduction in cases of simple luxations of the phalangeal articulations, even when the patient is seen soon after the accident has occurred, is well known, and the same difficulty exists in reducing and retaining in place compound injuries of this class. So hard is the reduction to effect, that it is asserted upon the authority of Bromfield, that the extending force has been increased to such a degree as to tear off the second joint in efforts to reduce the first. In compound luxations of the thumb, when found irreducible upon the application of a moderate degree of force, I believe the best practice to be that which was pursued in the above case, viz., to saw off the end of the projecting bone. If the wound be large, and this be not done, observation shows that, even when the part can be reduced, the dislocated end will in the majority of cases become displaced, as the inflammation necessarily following it prevents the application of a sufficient degree of force by bandages and splints to retain it in its natural position. One case of this kind I have myself witnessed, and another instance which occurred in Guy's Hospital has been published, where, although the phalanx was readily reduced immediately after the accident, so much inflammation and constitutional disturbance occurred as to make it necessary to remove the splints which had been applied, and resort to cataplasms; the patient being ultimately cured, after entire loss of the first, and exfoliation of the extremity of the second phalanx. Resection of the phalangeal extremity is the practice recommended by Sir A. Cooper in compound dislocations of these parts, where difficulty is experienced in their reduction, and has often been done with good success. Gooch states that he sawed off the head of the second bone of the thumb, and that a new joint afterwards formed. In two instances where the head of the metacarpal bone of the thumb was dislocated towards the palm accompanied with wound, and reduction was difficult, the protruding parts were successfully sawn off by Mr. Evans. Bobe, Wardrop, and Roux have all been successful in like cases. The bad effects resulting from these injuries where the head of the bone is replaced, and which seem to be at least in part owing to the force necessarily made use of, and the state of tension afterwards kept up in the surrounding soft parts by its return, have been often noticed. An instance came under my care, in which high inflammation and tetanus ensued upon the injury, where this practice was pursued; and Mr. S. Cooper reduced a case at the North London Hospital, which was followed by severe inflammation, terminating in death a week after the accident.

One of the dislocations of the humerus was accompanied with a fracture of the neck of the bone, and was happily reduced by the resident, Dr. Edward Hartshorne, who published an account of it in the *Medical Examiner* for 1842. The patient was a young circus rider, who had been injured by a severe blow from a horse one hour before admission. The head of the bone was thrown forwards under the clavicle, and was reduced without difficulty by manipulation with the hand, while the patient was feeble and relaxed, and the fracture afterwards treated in the usual way, with a good result. Another instance of this rare accident presented itself in my service in 1853, and, though not included in the tables, I have thought it might be of interest to give it a place here.

The patient, aged 32, was admitted on the 31st of October. He was under the effects of liquor, and it was stated that he had fallen down a flight of stairs. On examination, the soft parts around the left shoulder were found to be very much contused, swollen, and discolored by effusion of blood; the extremity was readily movable in any direction, but the slightest motion produced great pain. No perceptible depression was noticed below the acromion; the elbow could be brought close to the side without force, and, on raising the arm and moving it for the purpose of examination, the grating of a fracture was felt.

The presence of these symptoms led to the belief that a fracture of the neck of the humerus existed, and the case was treated by means of a pad in the axilla, with a pasteboard splint moulded to the shoulder on the outside of the arm, and bound to the body with the forearm supported by a sling.

This treatment was continued till the 26th of November, the dressing being occasionally changed. On their removal at the last-mentioned date, the swelling having by this time almost entirely disappeared, it was discovered that the head of the bone had been thrown from its socket into the axilla. At the first glance I thought that my original diagnosis had been incorrect, and that, in fact, I had mistaken, and had been treating a dislocation for a fracture; but, upon closer examination, it proved that such was not the case, but that both a fracture and dislocation existed.

The appearances presented by the parts at this time were as follows:—

To the eye there was evidently a slight vacuity immediately below the acromion process, though there was not that deep depression which exists in uncomplicated luxation. On rotating the arm, the broken shaft of the humerus was perceived to move under the acromion at the same time that the rounded head of the bone could be easily felt in the axilla, and the distance of this fragment from the upper end of the shaft, which partially occupied the glenoid cavity, was, as nearly as could be ascertained, from two to two and a half inches. The shoulder was not firmly fixed as is commonly seen in luxation, particularly when the member has been kept quiet, as was the case under examination; but, on the contrary, was easily movable, and when the patient stood erect, the elbow come in contact with the side of the chest. In order to prevent any mistake as to the nature of the accident, I requested my colleagues in the hospital to visit the case, and, after careful separate examinations, they all agreed as to its being one such as I have mentioned, viz., of fracture of the neck of the humerus conjoined with a displacement of its head into the axilla.

In consequence of the comparatively good use of the limb, which the patient seemed likely to attain, and the slight probability there was of the head of the bone ever being replaced, together with the risk of giving rise to severe inflammation about the joint, and consequent firm anchylosis; if any attempt at reduction were tried, it was decided that no efforts to replace it should be made. Gentle frictions to the part, with passive motion to the shoulder, after all traces of the great contusion and consequent inflammation which attended upon it had been subdued by a state of rest, was the treatment afterwards resorted to, and the patient was discharged on the 1st of January, with a strong and useful extremity, but with inability to elevate the arm beyond an obtuse angle from the body. The dislocation of the head of the humerus which accompanied the fracture of the neck of the bone, in the above case, it will be observed, was not at first detected, although the seat of injury was carefully examined. The accompanying swelling and contusion of the soft parts, the distinct crepitus of a fracture felt upon handling the limb, and the other marked symptoms of that accident which it presented, together with the absence of the ordinary marked ones of luxation, viz., the fixity of the extremity, the hollow at the extremity below the acromion, and the ease with which the elbow was brought to the side of the body, all caused it to be overlooked.

The difficulty of diagnosis, in connection with the great rarity of the injury, alone makes the above case worthy of notice; but, in addition to this, the proper plan of treatment to be pursued in these accidents, supposing the diagnosis to be made out, does not seem to be well determined by surgeons.

In the treatises on injuries of the bones, of Sue, Petit, Boyer, and Smith of Dublin, no mention is made of luxation accompanied with fracture of the neck of the humerus, and but few cases of it are to be found detailed in our surgical records.

Delpech[1] furnishes an accurate account of a dissection of this kind, which was observed by M. Houzelot, but it had not been ascertained during life. Dupuytren has reported a single case which he saw at the Hôtel Dieu, which was not reduced. In 1832, an instance of it was witnessed in the service of Mr. Earle, of London, which was replaced by his dresser a short time after the accident had occurred, and two cases are to be found very accurately described by Peyrani,[2] neither of which were reduced. In the last edition of Sir Astley Cooper's treatise on Fractures and Dislocations of the Joints, but five cases of a similar nature are noticed. Of these, the character of the accident was not discovered in three of them, until revealed by post-mortem examinations. In a fourth, the fracture was comminuted, and no attempts at reduction were made, and the fifth, which was an injury of six weeks' standing, and observed at Guy's Hospital, in 1834, by Sir Astley in conjunction with Mr. Key, was mistaken for an ordinary luxation, and the fracture was not suspected till after the pulleys had been applied, when, its true nature becoming apparent, all further efforts to reduce it were desisted from. M. Richet reduced a dislocated shoulder accompanied with a fracture of its neck, by holding firmly the acromion, and pushing the head of the bone outwards and upwards with the fingers.

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[1] Chirurgie Clinique, tom. i. p. 241.

[2] Journ. de Chirurgie, tom. iv. p. 180.

In nineteen cases of luxation with fracture of the humerus collected by Malgaigne[1] the luxation was overlooked in five, and he adds, that he himself erred in his diagnosis in another case. In two instances of dislocation of the humerus with fracture of its surgical neck seen by Dr. J. Mason Warren,[2] "while the muscles were still relaxed, and before the patient had recovered from the depressing influence of the shock, it was found possible to effect reduction by making extension of the shaft of the bone, at the same time working the separated head into its socket by firm pressure with the thumbs."

In regard to the treatment in these cases, I have stated that surgeons are not well agreed. Delpech after inspecting the parts in the patient of Houzelot, reasons upon it, and concludes that the reduction of the bone in these accidents is impossible. Sir Astley Cooper[3] thus expresses himself: "Extension is of no further use than to bring the broken shaft of the os humeri into the glenoid cavity, where it forms a useful articulation; but no extension however violent disturbs the broken head of the bone, for no proper force could bring it into the glenoid cavity of the scapula." "Let the surgeon do what he will, the head of the bone will probably remain in the axilla, and the upper motions of the arm will be in a considerable degree lost." Dupuytren says:[4] "When luxation is accompanied with fracture of the surgical neck, art and nature can do almost nothing." We have seen, however, that in some of the instances I have alluded to, success has followed the efforts made to thrust back the head of the bone into the glenoid cavity, and these should lead us, I think, to make some efforts to accomplish it in all cases when seen early, though, for the reasons already mentioned, I should myself be disinclined to attempt it, except when it is very recent, and then by no other force than such as can be exerted by the pressure of the hand.

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[1] Traité des Fractures et des Luxations, tom. ii. p. 203.

[2] Surgical Observations, p. 352.

[3] Loc. cit., Lond., 1842, p. 427.

[4] Leçons Orales, tom. iii. p. 116.

A case of true dislocation of the fifth from the sixth cervical vertebræ, unattended by any fracture, is included in the above tables, an accident of such rare occurrence, that it is deemed worthy of record. The following are its details:—

Thomas Lee, aged 30, was admitted early on the morning of September 9, 1831. At 11 o'clock on the previous night, while in a state of intoxication, he had been thrown headlong against the curbstone from a gig that he was driving along at a furious rate. There was complete paralysis of the lower extremities, chest, and lower half of the trunk. He complained of great pain over the lower cervical vertebræ; but so much swelling and ecchymosis existed at this part, that the state of the spinal column could not be satisfactorily ascertained. When placed in an erect position he cried out from pain, unless his forehead was firmly supported; and, when laid on his back, his head was seen to be thrown a little forwards, and pushed down upon his chest. The hands and arms retained their sensibility, but he was unable to double his fist, or seize anything firmly. His respiration was hurried, difficult, and performed entirely by the diaphragm; he complained incessantly of being unable "to breathe properly." Priapism existed, and continued constant till the period of his death. From the existence of the above symptoms, the case was looked upon as one of fracture, with consequent luxation of the lower cervical vertebræ. He was placed on his back, with the head and shoulders slightly elevated, had his bladder, which was distended, emptied by the catheter; and, as his pulse was full, he was bled moderately. By 10 A. M. his sufferings had become so great, that Dr. Barton, the surgeon in attendance, deemed it proper to make some attempt to relieve them, by cautiously making extension and counter-extension. The extension was made by means of a handkerchief passed under the chin, the ends of which were tied firmly to the head of the bedstead, and the counter-extension was kept up by securing the ankles with a broad bandage, and fastening it to the foot-board. The patient expressed himself as being decidedly easier after the extension was made. On visiting him on the morning of the 11th, I found him without pain, and with no apparent change in his symptoms. His position was in no way changed; and, while in the room engaged with another patient a few feet distant, my attention was directed by the nurse to Lee, and on approaching him I found him dead.

Autopsy.—A considerable effusion of blood was found in the cellular tissue beneath the skin, as well as between the muscles on the back part of the neck. The yellow ligaments and the ligamentous fibres, holding together the oblique processes, were ruptured, and the fifth cervical vertebra was thrown forwards upon the sixth. Examined in front, the vertebral ligaments were found also to be ruptured, and the inter-vertebral substance torn up, so that the body of the fifth was completely separated from, and projected over, the sixth. Accurate examination, after the removal of the upper part of the spinal column, proved that no fracture existed, and that the injury consisted in a simple displacement of both body and processes of the vertebræ. The examination was made twenty-eight hours after death, but, owing to the heat of the weather, putrefaction had considerably advanced, and the spinal cord, the coverings of which were uninjured, was so much softened in its whole extent, that its state at the point of injury could not be determined.

ON COMPOUND FRACTURES.

THOUGH wanting in the charm of novelty, the subject of compound fractures is one of much practical interest to the surgeon, and involves the consideration of so many of the fundamental principles of our science, that but few will be found to question its claim to careful study. The variety and frequent occurrence of these accidents, the serious complications which they oftentimes present, the violent constitutional symptoms to which they may give rise, and the importance of their proper treatment, not only to the patient, but to the lasting reputation of the practitioner, added to the necessity of often determining speedily one of the most difficult and delicate questions which the surgeon is ever called upon to decide, viz., whether a limb must be sacrificed in an attempt to save life, or whether the injury is one which will allow of a reasonable hope of recovery without amputation, all make them worthy of oft-repeated consideration.

The wound in cases of compound fractures is variously produced: sometimes it is made by the action of the body causing the fracture, as where the wheel of a heavy carriage passes over a limb; in other instances the bone is first broken, and the extremity of one of the fragments, generally the upper, is pushed through the soft parts, either in consequence of some exertion made by the patient after the injury, or by the involuntary contraction of the muscles; and in some cases the fracture becomes compound only by the process of ulceration, the formation of an abscess, or by the separation of sloughs, resulting from the severe injury the soft parts have met with. In the first of these classes the wound is generally large and accompanied with great laceration, the bone being often comminuted, and the case altogether one of the most serious kind; but in the second class the external injury is mostly of small extent, and no other parts are injured than those with which the bone comes in contact—union of the wound by the first intention frequently follows, and, even if this desirable event is not obtained, it is soon covered by granulations which speedily cicatrize.

In compound fractures, the age, habits, and constitution of the patient, the season of the year, the seat of injury, the mode in which the accident has happened, and the degree of violence done to the soft parts, have all to be taken into consideration before a well grounded opinion of its probable result can be come at; and these subjects, in the order in which they are mentioned, I shall now consider.

Age, habits, and constitution.—When occurring in advanced age, these accidents are always of a most serious nature, and this less from fear of the reparative process being deficient, than from the fact that patients of this class bear confinement to bed badly, being much more exposed thereby to sloughing, passive congestions, and internal inflammations than younger persons. As after all other injuries, free livers, those of broken-down constitutions, and intemperate persons are in more peril from them than individuals of an opposite class; and in the latter the danger of the occurrence of delirium tremens is always great, and when it occurs in many cases proves fatal.

Season.—The degree of heat exerts considerable influence upon patients suffering from these injuries, the constitution bearing up against them better in temperate or cold weather, than during the excessive heats of summer. The marked deleterious influence of our hot weather upon patients so situated has been noticed by all practitioners; at such times the appetite soon gives way, the strength fails, diarrhœa and hectic symptoms supervene, and the patient sinks much sooner than at other seasons.

Mode in which the accident has happened; seat of injury.—A compound fracture produced by force applied directly to the seat of injury is always a more severe accident than when the wound results from the end of the bone being driven through the soft parts. When seated in the immediate vicinity of a large joint, the injury is more serious than when occurring near the central part of a bone, there being then considerable risk of the neighboring articulation being opened by the extension of the inflammation consequent upon the injury; the difficulty of retaining the fractured parts in apposition after reduction is also generally greater when near to a joint. In making a prognosis, too, it is of importance to consider the limb affected, those of the upper extremity being less dangerous than of the lower, and as a general rule it may be stated that the nearer the fracture be to the trunk, the greater the risk incurred by the patient. In the country, or in private practice, the chances of saving a limb in these accidents is always greater than in large cities or in hospitals. In civil hospital practice, compound fractures of the arm and forearm generally do well; in the leg, under the same circumstances, where an attempt is judged proper to save the limb, the accident is more serious, and a number must either suffer secondary amputation or die, and in the femur the majority of adults will not survive them. Of fifteen cases of compound fractured femur treated in the Pennsylvania Hospital between the years 1830 and 1840, four were in children below thirteen years of age. In one of these (ætat. 6) the wound healed kindly, and no bad symptoms followed; in another case (ætat. 7) the patient was carried home by his parents and recovered; in a third (ætat. 11) the patient died; and the last (ætat. 12) recovered with a good limb. Of the eleven cases above thirteen years of age, seven died within two weeks after the receipt of their injuries; an eighth (ætat. 18) lived three months, and died of metastatic abscess; a ninth (ætat. 56) died at the end of eleven months of chronic diarrhœa, bony union at the time being perfectly firm, though the wound had not closed; and the other two cases (ætat. 21 and 15) recovered with good limbs, though in the first case not till after twenty-three months, and the removal of a necrosed portion of bone six inches in length.

With the exception of compound fractures produced by machinery and railroad accidents, those from gunshot are more dangerous than such as are met with in civil practice. In the leg, where both bones are comminuted, they generally require amputation, and, in the middle or lower parts of the thigh, until of late years this indication was thought to be almost imperative, such accidents in this bone being attended with a very great degree of danger. Of eight cases treated in Holland by Mr. S. Cooper, seven of which were not amputated, only one recovered, and that patient retained an useless limb. On a review of the cases seen by him during the Peninsular war, Mr. Guthrie found that not more than one-sixth recovered so as to have useful limbs, two-thirds of the whole died, whether amputation was performed or not, and the limbs of the remaining sixth were not only useless, but a constant source of uneasiness to them for the remainder of their lives; and Hennen, one of the best of our older authorities in all matters of military surgery, asserts that, without having made any accurate calculations, he is strongly inclined to assume Mr. Guthrie's estimate as correct, "even including the cases of officers who are not subjected to the risks encountered in crowded hospitals. In these situations," says he, "the cases which I have witnessed have, on some occasions, been deplorable. Not a single case has done well where amputation was deferred, and even where it has been performed two out of three have died. In other instances, the losses have not been so severe, but I have never known a larger proportion saved than that assigned by Mr. Guthrie."[1] The testimony of the French army surgeons strongly corroborates that which we have just given. Percy states that scarcely two in ten of such cases recover. M. Ribes, who has never seen a single cure, gives ten examples which despite of every possible attention proved fatal, and says, that, out of four thousand individuals at the Hôtel des Invalides, there was but one who had been cured after this injury. In 1815 Mr. Yvan showed two to him, in both of whom fistulous openings leading to the bone existed, and who ultimately died of affections resulting from their accidents.[2] Dupuytren, when giving the results of his long experience in compound fractures from gun shot, says, "On one point my opinion is unchangeable. In rejecting amputation in them more lives are lost than limbs saved."[1]

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[1] Principles, 3d edit., p. 110. London, 1829.

[2] Gazette Médicale, 1831, p. 101.

Cases demanding immediate amputation.—The first question which arises in the treatment of compound fractures of a severe kind is to determine whether or not the sacrifice of the limb by amputation be necessary. For the determination of this point, it is difficult to lay down any precise and fixed rules, as every instance offers something peculiar to itself, and all that can be done to aid in determining this highly important question is to make known the principles which should guide us in a general way, and in urging the propriety of invariably delaying the operation whenever a reasonable doubt as to its necessity arises. The age, constitution, and habits of the patient must be considered, as also the degree of care and attention which he may be able to command during the treatment. Amputation may be proper after a compound fracture in an elderly person, or one of enfeebled constitution, or of intemperate habits, or in a patient who is to be treated in a crowded hospital, or where any considerable transportation from the place where the injury was received becomes necessary, when the same kind of injury would not demand it in a young subject, or one of good constitution and habits, or in an individual living in the country, or placed in a pure and uncontaminated atmosphere. Authorities of the present day are generally fully agreed upon the necessity of amputation in the following cases:—

1st. Where the bone is comminuted, and the soft parts so much contused, lacerated, or destroyed as to make it evident that gangrene must follow.

2d. Where the bone is fractured and a portion of the limb torn off by machinery, the bursting of a gun, a cannon shot, or the passage over the part of a railroad car.

3d. Where the laceration of the soft parts around the fracture is very extensive or extending into a large joint, even though the bone be not comminuted.

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[1] Traité des Blessures par Armes de Guerre, tom. i. p. 465. Paris, 1834.

4th. Where the fracture, though accompanied with but little laceration, extends through the head of a bone into a large joint, as the knee or shoulder.

5th. Where the bone is fractured in more that one point and accompanied with great laceration and contusion of the surrounding parts, or in cases where the bone is extensively exposed with the soft part separated from it, especially if the fracture be in the neighborhood of an important articulation, and has been produced by the application of direct force.

6th. In cases where the injury is not so extensive as in the instances mentioned, but is accompained with the division of the principal artery and nerves, for though neither the division of the vessel, the laceration, nor the fracture may alone justify the removal of the limb, yet the whole together will frequently make it necessary. Primary hemorrhage alone can rarely, if ever, require it. Where no other indication for it is present, the ends of the vessel should be secured at the point of injury, or if this be impossible or inexpedient, the main trunk above it. In all of these cases great danger to life arises from the violence of the reaction, the sloughing, the profuse suppurations, and secondary hemorrhages (even supposing mortification should not occur) that necessarily must take place after injuries such as have been mentioned; and the removal of the injured part by amputation, and consequent substitution of a clean wound for an extensively lacerated and contused one, evidently offer a better chance of life to the sufferer.

The operation of amputation however, it should be recollected, is of itself always attended with danger, and this varies in degree according to the part which is removed; amputations of the lower being more dangerous than those of the upper extremity, and the danger of the operation increasing the nearer to the trunk it be performed.

The great mortality following the operation of amputation deserves to be glanced at in making up an opinion as to the propriety of attempting to save any case of compound fracture, since it by no means follows, as many seem to think, where these accidents terminate fatally in our attempts to save them, that life would have been preserved had the operation been done, and is another cogent reason for giving to the patient the benefit of even the slightest rational doubt in determining upon the question of amputation.

The remarks here made in regard to efforts to save limbs do not however apply to military practice. Hennen lays it down as a rule, that "the sum of human misery would be most materially lessened by permitting no ambiguous case to be subjected to the trial of preserving the limb; constitution, convenience for treatment, and local circumstances having their full weight in the decision," and his rule to operate in such cases is, I think, received and acted upon by most of the experienced army surgeons of our period.

Period for amputating.—The necessity of amputation being recognized, it becomes a question at what period the operation should be done. Upon this point great difference of opinion has existed among surgeons, and much attention has been bestowed upon it ever since the period that the question was agitated by the French Academy of Surgery, one set of practitioners with Boucher at their head insisting upon the advantages to be derived from the immediate removal of the limb after severe injuries, while others with Faure advocated the propriety of postponing the operation till some days have elapsed after the receipt of the injury. The strongest advocates for immediate amputation, both in the last and present centuries, have been among military surgeons, and a careful examination of the facts adduced by them in support of their views must, I think, convince the most skeptical of the propriety, or rather necessity, for the performance of immediate amputation after compound fractures, or other severe injuries of the extremities produced by gunshot, when occurring in camps or on the field of battle.

In some compound fractures about the joints when from gunshot, the necessity of amputation may be avoided by resection of the articular ends. This procedure is particularly applicable to the shoulder, though it has been employed in the hip and other joints. The propriety of resecting the head of the bone in cases of shattered os humeri has been much insisted on by Larrey. During the campaign of Egypt, he practised it in ten instances, thereby obviating the necessity for amputation, and his statements of the benefits resulting from it have since been confirmed by later writers.

The operation, as done by Larrey, consists in exposing the head of the bone by an incision made in the centre of the deltoid muscle, parallel with its fibres, separating it from its attachments, and removing the whole of the fragments. The arm is then to be carefully supported, and fixed by means of an appropriate sling. Of the ten cases mentioned, one died of hospital fever, two of scurvy, a fourth after recovery, of the plague, and the remainder returned to France in good health, the humerus becoming anchylosed to the scapula in some of them, and in others an artificial joint having formed that admitted of good motion.[1] The cases to which the practice is applicable are those unaccompanied by injury to the axillary vessels, or principal tendons about the joint, and where the laceration of the soft parts is limited to the deltoid muscle and not in an extreme degree.

Many, however, believe that simple enlargement of the wound, and removal of all splinters from it, are often alone sufficient and commonly the better practice. Dupuytren[2] held this opinion, and Dr. Mann,[3] an experienced surgeon of our army during the war with Great Britain, asserts, that when the general health is good, the limb can generally be saved by a careful removal of the splinters alone. Mr. Guthrie,[4] who thinks excision may be practised in some instances where the splintering is confined to the head and neck of the humerus, adduces cases to prove that, even where the head of the bone is greatly shattered, it is not always necessary; and Hennen,[5] than whom we have no higher authority, states, that the practice is not generally adopted, and "believes upon the whole that the excision of the head of the humerus will be found to be more imposing in the closet than generally applicable in the field."

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[1] Military Memoirs, trans. by Hall, vol. i. p. 330.

[2] Leçons Orales, tom. ii. p. 530.

[3] Medical Sketches.

[4] On Gunshot Wounds, p.

[5] Loc. cit., p. 40.

Since the period at which Hennen wrote there has been a marked change of opinion in the profession on the subject of excision of joints, and the operation has been extensively practised both in civil and military life in the shoulder, elbow, hip, and knee. In our late war[1] five hundred and seventy-five cases of excision of the shoulder-joint for gunshot fractures have been reported, in sixty-seven of which the results were undetermined. Setting these aside, we find of the two hundred and ten primary operations that fifty died, and one hundred and sixty recovered, a mortality of 23 per cent.; while two hundred and ninety-eight secondary operations gave one hundred and fifteen deaths and one hundred and eighty-three recoveries, a ratio of 38.59 per cent., or a mean ratio of 32.48. "The ratio in amputation of the shoulder-joint," adds the compiler, "is 39.24, a percentage of 6.76 in favor of excision."

"Of thirty-six cases of gunshot fracture of the head of the humerus, selected as favorable cases for the expectant plan, and treated without excision or amputation, sixteen died, or 44.4 per cent., a ratio in favor of excision of 11.96 per cent."

Of two hundred and eighty-six cases at the elbow in which the results are ascertained, sixty-two cases terminated fatally, or 21.67 per cent., "which is a mortality a fraction greater than that resulting from amputations of the arm."

In regard to the hip-joint, the statistics of the war give twenty-one cases of amputations of that part for gunshot fractures, of which nine were primary, and twelve secondary. Of these, two of the first class were successful, and one of the secondary. In the Crimean War the operation was uniformly fatal.[2]

"Of the sixty-three cases submitted to excisions of the head, or of the head and neck and trochanters of the femur," thirty-two were primary, of which two succeeded; twenty-two were intermediate, of which also two succeeded; nine were secondary, of which one alone did well.[3]

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[1] Circular No. 6, Surgeon General's Office, p. 55, 1865.

[2] Ibid., p. 49, 1865.

[3] Circular No. 2, Surgeon General's Office, pp. 20–54, 1869.

"Among one hundred and twenty-two cases treated by temporization, cases in which the testimony is direct and positive that gunshot wounds of the hip-joint, with fractures of the head or neck of the femur had been detected by competent observers, eight examples of recovery are recorded. This gives a mortality of 93.04, a more deplorable result than either amputation or excision present."[1]

Dr. Otis, the able compiler of these statements, thinks, "a sufficient number of instances have been collected to permit precise rules on this subject to be established," and says:—

"Amputation at the hip-joint for gunshot injury, notwithstanding its great fatality, cannot be altogether discarded and should be performed: 1. When the thigh is torn off, or the upper extremity of the bone comminuted with great laceration of the soft parts in such proximity to the trunk that amputation in the continuity is impracticable. 2. When a fracture of the head, neck, or trochanters of the femur is complicated with a wound of the femoral vessels. 3. When a gunshot fracture involving the hip-joint is complicated by a severe compound fracture of the limb lower down, or by a wound of the knee-joint."

"Primary excisions of the head or upper extremity of the femur should be performed in all uncomplicated cases of gunshot fracture of the head or neck."

"Expectant treatment is to be condemned in all cases in which the diagnosis of direct injury to the articulation can be clearly established."[2]

When none of the circumstances are present demanding immediate amputation or resection, the fractured bone is to be reduced, and the wound dressed with a view to procuring its reunion. The attempt to promote union by the first intention should in favorable cases be made, though judging from what is said by writers, as well as from what I have seen in my own practice and that of others, this desirable result is rare in compound fractures. By attempting it, nevertheless, we lessen the inflammation which necessarily follows, diminish the discharge of pus, and assist materially the union by granulation. Previous, however, to the dressing being arranged, the hemorrhage, if any, is to be arrested, the clotted blood, loose splinters, and foreign bodies removed, and the wound carefully cleaned.

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[1] Ibid., p. 115, 1869.

[2] Ibid., pp. 122–3.

Hemorrhage.—The first thing which commands attention in the dressing is the arrest of hemorrhage. If this be arterial and free, pressure or a tourniquet should be applied over the main artery of the limb until the divided vessel can be secured, and in all cases where it can be done, both ends of the divided vessel, if large, should be tied. But mischief may be done by the long-continued application of a tourniquet, and it cannot be too forcibly impressed upon the young practitioner, that this instrument is never to be used except for mere temporary purposes. When kept long upon a limb, besides being painful, œdematous swelling is sure to follow, and if its application be long continued, mortification would be the result. As a patient under such circumstances is always more or less chilled and prostrated, every vessel pouring out blood, even though of small size should be taken up, in order to avoid a recurrence of the bleeding when the parts become warm and reaction is established. Venous hemorrhage may always be arrested by rest and position, either alone, or combined with the application of cold, or moderate compression.

Removal of foreign bodies.—Dirt or foreign bodies are to be carefully removed from the wound, including under this last head, all pieces of bone that are not adherent to the soft parts, and in an examination for these, or other purposes, the finger is at all times to be preferred to a probe. Some go so far as to recommend the removal of all loose fragments even though they be not entirely detached from the surrounding tissues, but the practice is reprehensible as well on account of the pain occasioned by it, as from the injurious effect which such removal exerts upon the length of the limb and the formation of callus. They should be left until they become spontaneously detached, and then removed. If the bone be greatly comminuted, or if splinters cannot be removed without causing pain and laceration of the soft parts, no objection exists to enlarging the wound, as by so doing we not only more easily get rid of the separated fragments, but also make a free exit for the discharge of pus. Where the fracture is unattended with comminution, the propriety of such practice is doubtful, as in such cases we expose to the air a much larger surface of bone and thereby render it more liable to exfoliation. Care should be taken where loose but attached pieces exist, when reducing the fracture, to place them as nearly as possible in their natural situation.

All foreign bodies and loose portions of bone being removed, the limb is to be placed in the position in which it is determined to keep it during the treatment, with the fragments, if possible, in accurate apposition, and such dressings applied as will be likely so to retain them. But supposing so long a time to have elapsed between the occurrence of the accident and the visit of the surgeon as to have allowed inflammation to set in, is reduction to be at once attempted, or is it to be delayed till the great pain, heat, and swelling have in a degree subsided? The experience of practitioners of the present day teaches the propriety of at once reducing the bone, and thus getting rid of one great cause of the inflammation. This, however, is not to be done by the sudden application of force alone, but by moderate and gradual extension, aided, if necessary, by enlargement of the wound, or removal of the end of the bone. Recurrence of the displacement is afterwards to be prevented by giving a proper position and support to the limb without the aid of tight bandages or great pressure, measures which would risk increase of the inflammation, and which not unfrequently have induced mortification or sloughing.

Position of the limb.—As in simple fractures of the lower extremity, two very opposite positions have been recommended for the treatment of compound cases. The bent position, extolled by Pott on account of its relaxing the muscles, has since his time been generally preferred by his countrymen, while in France, the straight position has been mostly adopted. In this country, neither method is exclusively employed, and by neither are all the muscles completely relaxed. I have witnessed both modes of treatment, and know that by both good cures may be made, but give a preference to that of extending the limb, inasmuch as it is easier for the patient, as well as his attendants, and permits of less disturbance of the fragments, while its results are fully equal to any that can be attained by the position of Pott, or the semi-flexion of the knee with the patient on his back. It is a great mistake to suppose the bent position to be the easier one for the patient. Hennen, who used the position recommended by Pott during the inflammatory stages of fractures, and after that period had passed placed the patient on his back, with his limb extended, when describing his treatment, says: "The patient is in general extremely tired of his relaxed position before the lowering of the inflammatory symptoms indicates the time for placing him on his back, a change from which he receives great relief," and in his reflections on the two positions gives the following strong testimony in favor of the straight one: "I am warranted, from ample experience, to infer that lying on the back, with the limb extended, is by far the most tolerable to the patient, and admits of much easier access and dressing; and, what is still more important, is, in its ultimate success, equal, if not superior, to either the bent position of Pott, the patient on his side; or the semi-flexion of the knee, the patient on his back." In compound fractures of the leg, I usually employ the common hinged box, and in those of the thigh, an apparatus on the plan recommended by Boyer, previously sawing out a portion of the splint opposite to the seat of injury, so as to allow of the application of dressings without disturbance of the limb, or permanent extension made by means of a weight and pulley, with narrow sacks filled with sand applied to support the sides of the limb, affords excellent results.

The important requisites for treating fractures successfully are coaptation and immobility, and in my judgment it matters little what particular apparatus is employed, provided it be made to fulfil these indications, and keep the limb quiet and firm, and admit of the dressings being removed and reapplied without giving pain to the patient, or moving the fragments. The simpler the appliances the better.

In compound fractures of the upper extremity, each case must require some particular adaptation of splints to it, though those ordinarily employed with openings opposite to the wounded part, or one carved to fit the limb, are mostly all that are required, taking care to keep the patient in bed, with the limb supported on a pillow till all fever subsides, and afterwards allowing him to move about with the part sustained by a sling. In compound fractures about the joints, where attempts are made to save the limb, the bones should be adjusted in that position in which the limb, if anchylosed, will be most useful to the patient. If the fracture extend near to the knee-joint, the straight position is to be chosen; if the elbow be concerned a right angle, and if the fragments cannot be so placed immediately after their occurrence, they should gradually be brought into it as soon as the inflammation subsides. Where joints in these cases are for a long time retained in a perfectly motionlesss state, strong adhesions of the surrounding tissues take place, unless some degree of passive motion be daily given to them, and this should be done by gently flexing and extending the articulation, but it is not to be begun till all inflammation has subsided, and some degree of union has taken place. If, however, any irritation is caused by this procedure, it should be allowed entirely to subside before the part is again moved, as otherwise we risk the occurrence of inflammation at the seat of injury, which, if severe, might terminate in profuse suppuration, and result in the loss of the limb.

Usually, the extremity is readily placed in a good position, but if difficulty should arise in reducing the protruding bone, it can mostly be overcome by placing it so as to relax its muscles, after which extension is to be made on the inferior fragment and the parts restored to their natural situation. But where the fracture has been caused by the application of force to the extremities of a bone, and where consequently the wound has been produced by the fragment, the smallness of the opening, by embracing it very tightly, may prevent the reduction—here the wound may be slightly enlarged, after which the reduction is to be again attempted, and will mostly be easily accomplished. If difficulty, however, is experienced after enlargement of the wound, and well-directed efforts to reduce the fracture, it is better to remove a small portion of the bone, than make use of much violence either to return it, or retain it in position, though as but few cases happen in which a fractured bone may not be replaced by giving the limb a proper position, and assisting it, if necessary, by enlargement of the wound, such a procedure is seldom absolutely required. During a period of three years that I held the place of resident surgeon in the Pennsylvania Hospital, where a large number of these accidents are received, there occurred but one case in which it became necessary to resort to resection of the bone, and in the course of twenty-seven years that I acted as one of the surgeons of the institution, I have witnessed but very few cases which required it in order to replace the fragment. But though this procedure be seldom absolutely demanded, it is a question whether in cases where, from obliquity or other causes, the bones, despite all proper attention, are likely to protrude after reduction, or require the application of much force to retain them in a proper position, it is not better to remove a portion of it, as by so doing we get rid of all tension about the seat of injury, at the same time that a free exit is made for the discharge of matter. Resection of the extremity of a bone in compound fractures, which with difficulty could be maintained in position after reduction, or which were altogether irreducible, was a common practice with the ancients, and by our immediate predecessors was looked upon as being often demanded, and it may be questioned whether the practice at this day is not too much neglected. Albucasis,[1] Fabricius, and most of the ancient writers direct resection of the ends in these cases, sufficiently to allow of their easy reduction. Duverney[2] was a strong advocate for this practice, he says: "If in a fracture with wound, one or both ends of the bone start out, and after trial to replace them, it cannot be effected through the danger of dilating the wound too much, as when it is very near the joint of the foot or knee, it should be sawed or cut with incisive pincers, especially if a considerable portion of each end was stripped of its periosteum." Towards the close of the last, and beginning of the present, century, after the work of Pott had drawn particular attention to these accidents, many cases were published proving the efficacy of this procedure, and judging from the reports of these writers, it appears to have been at that time a favorite and happy practice. Gooch, in thirteen compound fractures, sawed off a considerable portion of the tibia and succeeded in curing both young and old subjects.[1] Sir George Ballingall, a writer of our own day, thinks, "that he has too frequently seen a reluctance to use the saw in removing the protruding extremities of the bone, when these were either difficult to reduce or of a sharp or spicular form."[2] The experience of Mr. Hilton, Surgeon to the Liverpool Infirmary, who has employed this practice extensively, is very favorable to it. In a period of twenty-two years, he sawed off portions of the fractured fragments in thirty-five cases of severe compound fractures of the leg, in which amputation of the limb was not considered justifiable, and lost only four cases—in the thigh of three cases of a similar nature, one died; of four instances in the humerus, one died; and of seven in the forearm and hand, two died.[3] Protrusion of the bones alone, however great in degree, can never be a sufficient cause for amputation. It has been stated as an objection to the practice of resecting the extremities of a fractured bone, that we risk in employing it the production of a false joint at the part, and the experiments of Sir Astley Cooper and others upon the inferior animals have been cited to show that by excising portions of bone no reproduction of the tissue occurred where the extremities were kept asunder. Cases too have been reported by Cooper[4] and Theden,[5] which show the same thing to have followed the removal of portions of the osseous tissue in man. These experiments and cases, it should be remembered, occurred in limbs composed of two bones, and the loss of a part of one of them without simultaneous fracture of the other, by preventing their being placed in contact, might well hinder firm consolidation. Very different, however, would be the result in parts in which a single bone exists, and we should be cautious in making a too absolute application of experiments on the formation of callus to cases of fracture with loss of substance, as facts of an opposite kind in great numbers might readily be adduced. The records of our science show that false joint rarely follows the resection of the ends of a broken bone in recent fractures, where the after-treatment is judicious and no general cause is present in the system to prevent consolidation.

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[1] Dict. de Méd., tom. xii. p. 504.

[2] Trans. by Ingham, p. 41.

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[1] Works, vol. ii. p. 286.

[2] Outlines, p. 336, 1838.

[3] London Med. Gazette, Dec. 1843, p. 396.

[4] On Fractures and Luxations, 4to. p. 116.

[5] Méd. Opérat. of Velpeau, tom. ii. p. 565, 1839.

Closure of the wound.—The fracture being reduced, the next step in the treatment is to close the wound, and promote its union by the first intention. For this purpose sutures were formerly much employed, but, on account of the pain produced in their application, their liability to excite inflammation, and the unequal pressure made by them upon the wound, they are now rarely used. Strips of adhesive plaster of such a length as to retain the parts in close contact when they can be so placed, without the use of forcible or long-continued means to produce it, and at such distances as to allow of the escape of matter when formed, are with us generally used for this purpose, the many-tailed bandage being afterwards applied. The use of these means will not, however, in the great majority of instances, be found to produce immediate union of the wound, and it is probable that the old practice of imbuing a piece of lint in blood, and allowing it to dry over the injured part, was more generally successful. It is, however, only in those compound fractures produced by the application of indirect force alone, that the attempt to effect union by the first intention is to be recommended. In these the skin and soft parts are in general but little injured, and the wound is mostly but of small extent, and where such is the nature of the accident, the practice of bringing accurately together the sides of the wound, even though the skin be extensively divided, should always be tried, and will not unfrequently be followed with good success. Where the injury has been produced by direct force, so much laceration and contusion usually accompany it, that no probability exists of procuring union, and even should the external opening under such circumstances be closed, the inflammation of the deeper seated tissues will terminate in suppuration, and necessitate a reopening of it; the pressure too made upon the limb by the adhesive strips, bandage, lint imbued in blood, or other means used in our attempts to produce it, only tends to aggravate this inflammation and increase the danger and extent of the suppurating surface. In such cases, therefore, the practice is to be deprecated. As little pressure as is compatible with keeping the bones reduced should be applied, and dressings of the lightest kinds only in temperate or warm weather, and a soft poultice, or lint with tepid water in the winter season, are more appropriate applications.

Many writers of the present day profess aversion to poultices, and decry them as greasy and irritating applications. My own experience leads me to look upon them when properly made, and covered with oiled silk, and not suffered to remain on the part till they become dry, stiff and sour, or not so heavy as to irritate by their weight, as applications of the most agreeable and comforting kind during the existence of high inflammation, or the sloughing process. In all cases their use should be discontinued upon the subsidence of the swelling and inflammation, as they then but encourage suppuration, and retard the healing of the wound.

Where the discharge of pus becomes profuse, or where hemorrhage from the veins or small arteries, either primary or secondary is troublesome, or is to be looked for, an excellent mode of treatment consists in fixing the limb in a good position in a fracture-box on a bed of dry bran, and surrounding and enveloping it with the same material. This application is soft, and agreeable to the patient, makes moderate and very equable pressure, which is increased in proportion to the increase of the hemorrhage or purulent discharge by the bran becoming moistened and expanding, and is unirritating to the wound, at the same time that it may be removed with the aid of a spatula or syringe, and reapplied without causing pain or disturbing in any degree the limb. No mode of dressing that I have ever made use of can be compared to that with bran in injuries of this kind attended with profuse suppuration, during our extreme hot weather. At this season the fetor arising from the discharge is often so powerful as to taint the air of a chamber, and in such cases maggots are generated in the course of a few hours, if the wound be in the slightest degree exposed. Clean bran, by covering completely and closely every part of the injured surface, hinders the deposit of the ova of flies, and at the same time prevents, in a great degree, the odor that would otherwise arise, by rapidly and effectually absorbing the discharge. It affords too an excellent means of applying cold by means of an iced bag laid on the surface, if on account of commencing inflammation it be judged necessary. The addition of carbolic acid to the dressing is also of service as a disinfectant, and tends to drive away the flies.

Water dressing.—The water dressing has of late years attracted much attention. In consists in one or two layers of lint folded and soaked in water, which are laid over the part and wetted as often as occasion may require. In cold weather, the lint should be re-soaked several times a day, and closely covered with oiled silk, to prevent evaporation. The continued application of cold water by means of the syphon has also been used in these injuries, and in hot weather will be found an agreeable and very effectual means of preventing or reducing a too high degree of inflammation, and its consequence excessive suppuration.

The following is a good mode of application: The fracture being reduced and well secured in a fracture-box, or other apparatus, the pillow upon which the extremity is placed being first properly protected by oiled silk or caoutchouc, and the wound covered with lint, and if necessary, the sides of it drawn together with adhesive plaster; one end of a long strip of lint is placed in a basin of cold water fixed on a table near to and above the level of the part, while the other end is laid over the lint covering the wound. This acting by capillary attraction keeps up a continuous irrigation of the parts, the water being carried off by causing another strip to connect the dressings with an empty basin placed upon the floor. The water may be made of a low temperature by the addition of ice, or medicated lotions may, if wished, be substituted for it. The treatment by irrigation is best adapted to the early stages of such fractures as occur in hot weather, and are accompanied by *great* laceration and contusion, hindering, as it often then does, excessive inflammation and being agreeable to the feelings of the patient. Except at this season, I am disinclined to its use, believing its employment to favor attacks of inflammation of the respiratory organs.

Immovable apparatus.—By any of the above methods of treatment, the dressings applied require frequent renewal, and the bad effects of daily disturbing them have been much dwelt on by some who look upon it as one cause of a high degree of inflammation following these accidents, and to prevent which they employ an apparatus which, by embracing the whole limb, renders the fragments perfectly immovable, and prevents the necessity of a renewal of them. Larrey, the introducer of the immovable apparatus to the notice of the surgeons of the present day, recommends, after the removal of foreign bodies, tying up the arteries, and cleaning out all extraneous matters and clotted blood, to bring the edges of the wound into apposition by means of perforated compresses spread with simple ointment, over which lint is to be laid, and then additional compresses imbued in some styptic gelatinous liquor. These dressings should be made to fit every part of the limb with great exactness, and upon becoming hard supply the place of splints. When the compresses are all applied, the many-tailed bandage is placed over them, and the dressings allowed to remain on during the whole period of cure. The use of the immovable apparatus in open fractures is directly opposed to that recommended by Pott, and generally adopted with us, viz., of dressing accidents of this class every twenty-four hours, and the advantages it possesses over this latter treatment are asserted by its advocates to be:—

1st. That it prevents effectually all contact of the air.

2d. That it diminishes the abundance of the suppuration.

3d. That it maintains the parts in a state of exact apposition.

That this treatment in compound fractures has been in very numerous cases followed with good effects by its introducer and his pupils, as well as by its more recent advocates, cannot be doubted, but the frequent occurrence of severe inflammation, abscesses, gangrene, and want of union, and where cures occur, the deformities seen in the hospital services in which it has been used, leads me here, as in simple fractures, to condemn its general employment. Its chief value is, I think, to be found in its adaptation to military surgery. In civil practice, it is particularly objectionable when placed upon the limb immediately after the occurrence of the accident.

The immovable apparatus has found great favor among the German surgeons. They usually employ the plaster of Paris as their immobilizing agent, and cut windows in it opposite the wound to give exit to the discharge.

Frequency of dressing.—The limb being placed and properly fixed in a good position by any mode of dressing which may be adopted, close watching on the part of the surgeon is necessary to insure a continuance of it. Until all inflammatory fever has subsided, which usually continues from ten to fifteen days, great irritability of the muscles with spasmodic contraction is sometimes observed, the dressings should be examined twice in the twenty-four hours, to guard against unequal pressure in any part, and correct any bad position that may have been assumed. Except where the immovable apparatus is employed, the wound at the morning visit should be regularly dressed, all discharges being removed, collections of pus opened, soiled dressings changed, and cleanliness particularly attended to. After the inflammation has abated, and the discharge is lessened, one dressing in the same period of time will suffice. To prevent the bed from becoming moistened and soiled, oiled silk or rubber cloth should be placed beneath the limb, and this together with the pillows and sheets upon which the patient is placed, and his body linen, occasionally changed. These various offices should all be done in the gentlest manner under the immediate superintendence of the surgeon himself and without effort on the part of the patient. In both hospital and private practice, duties such as these are sometimes left to the nurse, and generally to the detriment of the patient. In well-regulated hospitals or with careful practitioners no bandages, no tightening or relaxing of an apparatus, dressing of the wound, important change of position, or handling of the limb of any kind is ever permitted except under the immediate superintendence of the surgeon or an experienced attendant. In fractures of the lower extremity, cradles made of hoop or wire should invariably be placed over the foot, to prevent the bedclothes from resting upon it, as deformity not unfrequently follows a neglect of this precaution.

In the leg, when the patient becomes restless during the treatment, good results may sometimes be attained by suspending the limb in a swing, using for that purpose either a fracture-box, an anterior splint, or such other form of apparatus as the practitioner may deem most suitable.

Complicated fractures.—The most common complications of compound fractures are, rupture of a large vein, nerve, or artery, previous disease of the bone, or luxation.

The hemorrhage resulting from the *rupture* of a vein, even when it be large, is in most cases readily checked by cold applications to the part assisted by a slight elevation of the foot of the bedstead, or moderate pressure with a pledget of lint; but there is always danger of mischief supervening upon it.

Laceration of a large nerve.—The diagnosis of this is easy, the paralysis that takes place below the seat of injury at once making it known, and, when occurring as it mostly does with wound of the artery, amputation is our only resource. Partial rupture of nervous trunks is followed by convulsive twitchings, severe pain, and partial palsy. In these cases, warm fomentations or poultices, together with the free use of opium, is the only treatment likely to afford any relief.

Rupture of an artery in compound fractures is at once made known by the degree of hemorrhage which occurs, the color of the blood thrown out, as well as by the flow being ejected per saltum. Should the artery divided be superficial, or the wound large and of recent occurrence, the application of a ligature to both ends of the vessel is required, but where the bleeding vessel is deeply seated, or the wound small, or several hours have elapsed since the occurrence of the injury, and great swelling be present, it is better to proceed at once to secure the main vessel of the extremity.

In these cases, which formerly were supposed always to require immediate amputation, the main artery of the limb has in several instances been secured and the treatment afterwards conducted to a safe termination. In a compound fracture of the leg complicated with wound of the posterior tibial artery, Dupuytren tied the femoral in order to arrest the bleeding, and the fracture, which was afterwards treated by the ordinary means, united well in a little more than the usual time.[1] In another case of fracture accompanied by wound of the popliteal artery, he afterwards pursued a like practice with similar success. In an instance of hemorrhage from the posterior tibial artery accompanying sloughing after a compound fracture of the leg, Mr. Syme secured the femoral, and firm bony union occurred in two months after the operation, although the woman was advanced in life (ætat. 82).[2] Like results have been published by Pelletan, Delpech, B. Cooper, Gerdy, and others.

Wound of the main artery, however, is in itself highly dangerous, and it is only in cases otherwise favorable that an attempt to save a compound fracture complicated with it is justifiable.

Disease of the bone.—These fractures may be complicated by previous disease of the bone. Some years ago I treated a case of this kind occurring in a carious tibia, and necessitating amputation—a practice which will mostly be requisite in this class of cases.

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[1] Leçons Orales, tom. iv. p. 618.

[2] London and Edinburgh Monthly Journal, 1842, p. 965.

Luxation.—As in the simple and more common forms of fracture, those which are open may be accompanied by dislocation. When this occurs, the misplaced bone should be at once returned to its socket, before permanently arranging the fracture. In the ginglymoidal joints this is generally accomplished, but in the orbicular ones, where the dislocated fragment is short, and the articulation surrounded by powerful muscles, it is more difficult, and sometimes even impossible. Every effort, however, should be made to reduce the dislocation, and if the fragment be sufficiently long to allow of its seizure, trials to return the head of the bone should not be relaxed till crowned with success. In case of a compound fracture occurring in an extremity, with a luxation of some other limb, the same conduct is always to be pursued, viz., at once to reduce the displaced bone.

During the regular treatment of compound fractures, accidents may occur which it will be proper to notice.

Delirium tremens is not unfrequently met with in hospital practice, in connection with fractured limbs, and is uniformly attended with much danger. It usually shows itself in thirty-six or forty-eight hours after the accident, and from the period of its setting in little or nothing can be done in the way of treatment for the fracture. The best method of managing compound fractures of the leg or arm, during an attack, is to bring the sides of the wound together with adhesive plaster, and after securing compresses of soft lint or charpie over the wound by the same means, to envelop the limb in a pillow. This should be large and well stuffed, and should be bound securely around the limb by means of a roller. The elasticity of the feathers is such that no fear of making too much pressure on the part need be entertained, and it will be found to *hinder* all motion, and to keep the fragments in apposition better than any more complicated apparatus: the limb bound up in the pillow is, of course, either to be secured to the bedstead, or what is better, held by an attendant. The treatment commonly pursued in our hospital in cases of delirium tremens is the use of opium in the early stages, gr. ij or iij, every two hours, beginning its use in the latter part of the day, and discontinuing it towards midnight, together with nourishing soups, and the moderate use of stimuli. The latter are generally given in the form of porter, brandy, and tonic and anti-spasmodic tinctures. In the latter stages of the disease, when the pupil becomes contracted, the opium is either omitted or very considerably diminished, and blisters are applied over the back of the head and neck.

Retention of urine is a frequent occurrence in bad fractures, arising in most instances from an inability to empty the bladder in the horizontal position. It generally occurs soon after the accident, and the surgeon in all cases should take care to ascertain that the functions of this viscus are properly performed. When retention exists, the catheter is the proper remedy, and it mostly happens that after a few introductions of it the habit of passing the urine is acquired in any position in which the patient may have been placed.

Erysipelas is observed sometimes to attack the class of injuries of which we are treating. It is generally heralded by a sense of coldness, or a distinct chill with nausea or bilious vomiting, and these are quickly followed by fever oftentimes of a severe kind. The tongue is heavily coated, and the appetite fails. The parts around the fracture become reddened, and more or less swelled and painful, and the discharge from the wound is for a time lessened and more ichorous in its nature. The treatment is simple—a mild mercurial purge in the commencement, followed by the use of effervescing or neutral mixtures, and the moderate use of tinct. ferri chloridi in doses of fifteen or twenty drops, when the fever runs high, and cooling drinks, are all the constitutional means required, and these combined, with the application of mild poultices to the wound and cold mucilage or washes to the inflamed surface, will in most instances suffice for a cure. A large hospital experience does not warrant me in recommending iodine, nitrate of silver, and other like preparations for the purpose of preventing the spread of erysipelas.

Collections of matter in the neighborhood of the wound often occur, as a consequence of erysipelas or other inflammation in the fractured limb, for the evacuation of which counter openings sufficient to allow of the free exit should be early made, and if possible in a depending situation. All surgeons agree in the good effects of these counter openings; the wound improves in appearance after them, the constitutional irritation and sufferings of the patient abate, and the appetite and strength rapidly augment.

Maggots.—The presence of maggots in the wound is often observed in our climate in open fractures during the heats of summer, and besides being unpleasant objects to the patient and his attendants, give rise when numerous to a disagreeable sensation of tickling in the part. The most effectual way of preventing their formation is by attention to cleanliness and hindering the deposit of the eggs of the fly by giving to the injured limb a complete covering with some light dressing. When once generated they are to be got rid of by directing a stream of cold water, or weak vinegar and water, over the part by means of a sponge or syringe, or by incorporating with the dressing some substance which is disagreeable to them, as carbolic acid, the tar or creasote ointments, etc. It has been observed that maggots avoid the living parts, while they seem greedy of the putrid matters discharged from a sore, and hasten the separation of sloughs, and it is thought by some that their presence in wounds is rather favorable than otherwise. I have rarely seen them where the discharge from a wound was thin, ichorous, and stinking, or the ulcer presenting a bad aspect. They are almost invariably found where the discharge is thick and creamy, and the granulations healthy and advancing towards cicatrization.

Excoriations and bedsores.—Extension and counter-extension being required in compound as in simple fractures, excoriations are apt to occur at the points pressed upon. To avoid all risk of this, the extension should never be violent enough to cause pain, but should be moderate, steady, and permanent. If constant pain is complained of at any point on which the dressings press, it should be immediately examined and re-adjusted. The restlessness of patients causes any apparatus to be easily displaced, and it is therefore necessary to smooth, tighten, and carefully re-examine it daily. Excoriation of the heel is most frequently produced by want of care in not having the extending band smoothly applied to the part, or by tightening it in too great a degree without having previously drawn down the limb with the hand. Sometimes, however, ulceration at this part is caused by the weight of the foot alone, and in these cases the application of a piece of kid spread with soap cerate, together with slight elevation of the heel by means of a small cushion of old linen or carded cotton, will mostly prevent it.

In patients who are long confined to one position in bed from any cause, continued pressure by obstructing the circulation in parts which have become debilitated, gives rise to ulcerations over the projecting parts of the skeleton, and their occasional occurrence in bad cases of compound fractures, from the length of time the patient is obliged to remain in one position, requires some notice of them in this place. Persons of lax fibre, and those inclined to corpulence, seem peculiarly predisposed to bed-sores, though they are most frequently seen in elderly persons. Occasionally they are observed to form rapidly in the young and robust, particularly when a disposition is shown by the wound to take on an inflammatory or sloughy action. In these states the surgeon should ever be on his guard in relation to them, inasmuch as they are often found to progress considerably without any complaint being made by the patient. The heel, the sacrum, ossa ilia, trochanters, scapulæ, and spinous processes of the vertebræ, are the parts most frequently affected. The skin, when about to take on the ulcerative action in these cases, presents a dull red color and becomes soft and œdematous, and if, when these symptoms show themselves, pressure be not at once removed from the part and means used to stimulate the debilitated vessels, the point at which the pressure is greatest assumes a leaden or blackish hue. The slough rapidly extends to all the parts pressed upon, and on its separation gives rise to an ulcer of bad character in which not unfrequently the bones are exposed. Aware of their frequency, the surgeon should from the beginning endeavor to guard against their occurrence, and in this respect much may be done by having the patient placed on a proper bed, preventing the sheets or his body linen from becoming creased or moist, and if allowable, occasionally with the assistance of intelligent assistants, changing him from bed to bed. A hair mattress, well stuffed, and rather hard than otherwise, should be selected, and the support for it be made either of iron or wood so as to be perfectly firm; in private practice if a sacking bottom bedstead is to be employed, it should be made firm by placing boards beneath the mattress. The sheet should be drawn tightly over the mattress, and this, together with the clothing of the patient, is to be carefully smoothed when displaced. If it be impossible to move the patient from bed to bed, the parts pressed upon should be frequently examined, and on the appearance of any discoloration, or complaint of uneasiness, should be daily bathed with a little spirits or soap liniment, and when any spot is unduly pressed upon, the weight of the body should be entirely removed from it by means of an air or water-bed, air-cushions, circular hollow pillows, or supports of carded cotton, or if these be impossible, by applying over it a large piece of kid spread with soap cerate. An air-bed is sometimes extremely useful. When, either from pressure made on the parts, or the action of the extending or counter-extending bands, sloughing has actually taken place, a flaxseed or carrot poultice, frequently renewed till the slough be separated, and afterwards an unirritating plaster, are perhaps the best applications, increased attention being at the same time given to relieve the part from the support of the weight of the body. Proper constitutional treatment is likewise to be carefully observed: the allowance of a generous diet with the use of porter and stimulants, the administration of tonics such as quinine, etc., attention to cleanliness, ventilation, and all other hygienic measures, will be found to exert a marked beneficial influence on these local affections.

Tetanus sometimes follows upon compound fractures, though from my own observation but rarely. A few years ago, I lost a case from this cause in the Pennsylvania Hospital. The subject of it was a young and healthy countryman who was admitted five or six days after a comminuted fracture of the forearm produced by an injury from a rail-car. According to the statement made by him, his fracture had been complicated with wound of a large artery, the hemorrhage from which had been arrested by pressure. The arm was bound up in splints, and when he presented himself the hand and forearm were completely mortified, and separation of the dead from the living parts had considerably advanced. To get rid of its great fetor I clipped off the mortified parts with scissors at the point of fracture without causing pain, and covered the part with a cataplasm, intending, after improvement of his general symptoms, to amputate. On the evening of the second day after admission, slight stiffness of the jaws was observed, and on the following morning well-marked tetanus was present, which terminated fatally on the third day. His treatment consisted in purging, the free use of opium combined with a small portion of calomel and stimulants, together with the application of cups and blisters to the spine, and poultices to the wound, a treatment which both my reading and observation lead me to think the best that we possess. Larrey has recommended amputation in cases of tetanus, but the practice has never been generally followed. Mr. Hammick, a surgeon who enjoyed good opportunities of witnessing the effect of amputation in these cases, thus speaks of it: "I have done it; I have seen it done; but all the patients died with an aggravation of their symptoms to a frightful extent."[1] Dupuytren also condemns it. Division of the principal nerves leading to the seat of injury has also been advised and practised, though with no better effect than amputation. The use of opium to allay suffering and soothe the mind after severe injuries, together with a diet not too low, and care to prevent exposure to drafts of air, assist very materially in preventing its occurrence, and attention to these apparently minute points cannot be too much or too often insisted upon.

The Calabar bean and chloroform have latterly been much commended, but I have not experimented with them. Ether I have known to be very freely used without benefit.

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[1] On Amputations and Fractures, p. 75.

Secondary inflammation and deposits of pus in distant parts.—One of the most dangerous complications that can happen as a consequence of severe injuries or operations, is the occurrence of secondary inflammations and abscesses in the internal organs, and as these are perhaps seen more frequently after compound fractures than any other class of injuries, it seems peculiarly proper to notice them in this place. Deposits of pus in the internal organs after severe injuries have been long observed. Paré, Valsalva, and Morgagni all make mention of them, and the latter has described them with some detail. Quesnay, Andouillé, and Bertrandi noticed the occurrence of abscesses in the liver after injuries of the cranium, and contributed to the French Academy of Surgery interesting papers on the subject. J. L. Petit[1] describes them with exactitude, and many of the more modern surgeons have mentioned their occurrence. It remained, however, principally for the pathologists of the present day to direct the attention of surgeons to their importance and frequency, as well as to elucidate their causes and mode of formation.

Secondary deposits may occur at any time during the treatment of persons who have undergone any surgical operation, or have suffered from injuries attended with suppuration, though usually it is about the tenth day from the date of these that they are first observed. No age nor class of patients is exempt from them, though they may be said to be more common in hospital practice, and among free livers, than in those of an opposite class; they are also more frequently observed after amputations performed for injuries than those done for chronic diseases. They are often formed with great rapidity, and in some instances their first symptoms are so obscure and insidious as scarcely to be noticed; the following signs, when occurring in the classes of cases we have mentioned, may lead to a suspicion of their formation. Marked rigors which return at irregular intervals, or a sense of chilliness of some hours' duration, and in some cases coldness of the limbs alone, mostly usher in the affection. Upon the subsidence of these, the skin for a short time is hot, and occasionally is covered with moisture, and soon takes a cadaverous aspect, becoming pallid and assuming a yellowish or livid hue. After a renewal of one or more of these paroxysms, returning at variable intervals, the symptoms above mentioned are followed by those of a low and typhoid state. The eyes are sunken and glassy, the sclerotica and parts around the mouth assume a yellowish tint, the features become sharp, and the countenance presents a peculiar anxious appearance. The tongue, at first moist, soon becomes dry and red at its edges. The pulse is rapid, rarely below a hundred, and without force. The abdomen becomes distended, and not unfrequently there is a disposition to diarrhœa. Absolute delirium rarely occurs, though generally either marked depression of spirits or slight wandering is observable.

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[1] Maladies Chirurgicales, tom. i. p. 6.

In addition to the foregoing symptoms, inflammation of some of the internal organs may arise. When the lungs are the seat of the deposit, slight cough or pain in the chest, with dyspnœa and great anxiety, is observed, though in the majority of cases unattended with effusion into the pleura, neither percussion nor auscultation assists materially in the diagnosis, the deposits being so small and so much scattered as to leave between their seats sufficient healthy tissue to prevent the detection of any deviation from the natural respiratory murmurs. When the liver is the seat of the affection, jaundice more or less marked, attended with pain or uneasiness in the region of the liver or right shoulder, and vomiting, sometimes are observed, though in many cases where this viscus is affected all these characteristic signs are wanting. The thirst generally is not excessive. The breath, often fetid, exhales a true purulent odor. Coincident with the occurrence of the symptoms just described, the work of cicatrization is suspended in the wound, which takes on an unhealthy sloughy aspect, the discharge from it becoming scanty, ichorous, and exceedingly offensive. Slight hemorrhages occur from its surface, the edges become detached and loose, as if the cellular tissue uniting the parts had been destroyed, and present like the rest of the surface a pallid appearance, while at the same time the affected extremity becomes more or less œdematous. At a more advanced stage, a thin bloody discharge escapes, which towards the termination of the disease resembles the washings of flesh. Sometimes there is absolute hemorrhage, which by frequent repetition carries off the patient.

Examinations of patients who have died with the above symptoms present lesions of various kinds, though all referable to the same cause. Most frequently numerous deposits of pus are found in the proper tissue of the viscera, or collections of puruloid serum in the serous cavities. These deposits have been found in all parts of the body, the brain, the heart, the kidneys, spleen, and even in the mediastina, the thyroid gland, and the loose cellular tissue of the extremities. The lungs and liver are their most common seat, and their characters in these organs are so marked, that it is scarcely possible to confound them with the results of ordinary inflammations. Generally they are seated near the surfaces of these viscera, are numerous, and varying in size from a hemp seed to that of a small nut. When pressed upon they feel like tubercles, and the surface of the viscus containing them is uneven to the touch. In the liver they are larger and are more central than in the other organs, and the matter forming them is more unequal in consistence, being very fluid in the interior and concrete on approaching their circumference. In the lungs the different phases of the deposit can be best seen. The posterior parts of these organs are more commonly affected than the anterior, and the lower lobes more frequently than the upper. In some parts of the lung they present the appearance of small circumscribed spots resembling petechiæ, while in others, the centres of these spots are marked by yellow points as if the seat of small drops of pus, and at other places the ecchymosed spots are nowhere visible, the purulent drops alone being perceptible. These are either concrete like cheesy tubercle or altogether fluid, some of them being encysted and others not. The tissue of the lung immediately around the abscesses sometimes presents a perfectly normal appearance, and after the matter has been removed and the parts washed, portions of it seem to have been dug out mechanically, while in others, the pulmonary tissue is more vascular, heavy, harder, and more friable than in a state of health.

Of the serous cavities the pleura is their most common seat. In a few days the matter thrown out is very considerable, and the membrane, scarcely changed in character, is covered with a layer of true pus of greater or less consistence, while the remainder of the liquid has an ashy tint.

In the articulations the state of the tissues is equally surprising: the cartilages, capsular ligaments, and other textures entering into their composition often presenting no trace of inflammation, although filled with pus. In some cases, however, the cartilages are in part destroyed, the synovial membrane and ligaments eroded, without the contiguous parts having in any way lost their healthy characters. The same may be said in regard to the subcutaneous or deeper seated deposits of the extremities, though occasionally they are surrounded by ecchymosis and traces more or less evident of inflammation. Some patients present these deposits in various parts of the body at the same time, though commonly they will be found but in a single organ. Sometimes they exist in the lungs and liver without accompanying effusions on their serous surfaces; in some cases there is effusion of pus into the cavities alone; sometimes they are found only in the extremities either within or without the articulations, and in some instances patients are carried off with all the symptoms of the affection strongly marked, without any trace of these or other lesions being found after death—the cause of death in such cases being attributed by Velpeau, and it appears to me correctly, to the blood itself having become altered in a greater or less degree by the admixture of some septic poison which probably has its origin in the suppurating wound.

Modern pathology has proved that these secondary deposits are due to small emboli which have been arrested in some of the smaller vessels of the tissue. It appears that usually a coagulation of blood takes place in the larger veins in the neighborhood of the injury—the clot often extending into the small venous radicles which arise from the bone. The central end of this thrombus usually undergoes softening, and particles of it, being washed off by the current of blood, are carried forward by the circulation, till, on entering some of the finer arterial capillary networks of the body (*e. g.* those of the lungs or liver), they, being too large to pass through, are arrested, thus causing a stasis and coagulation of blood in the adjacent vessels which give rise to inflammation and the formation of abscesses.

As regards the treatment of these affections but little is to be expected from the use of any general remedies. Venesection, at one time much resorted to on account of the supposed inflammatory origin of the deposits, is now justly discarded, all who have used it agreeing that its employment seemed only to hasten their development. Velpeau, whose experience in this affection was large, asserts that he has seen blood-letting employed, either in his own practice or that of others, in a large number of cases, and in a good proportion carried as far as prudence would allow, without having ever observed any good effects from it. Dupuytren was favorable to the use of blisters; if used they should be large and applied to the legs, thighs, abdomen, or chest. Moderate purging and the use of diuretic tisans are thought to be of some efficacy. Tonics and stimulants should be employed freely, and a nutritious diet always allowed. The local treatment of a wound, when symptoms of these secondary abscesses are threatening, or set in, is of great importance: a free exit should be made for any discharging matter, and the dressings should be light and frequently changed. If the discharge has greatly diminished in quantity, poultices or the warm water dressing should be applied with the view of determining the fluids towards the wound. The application of a roller from the wound towards the trunk is highly lauded by some. Velpeau asserts that of all the local measures employed there is none in which he has as much confidence as this if applied before the pus has been carried in any quantity into the circulation, as we thereby cut off the poison and give the vital powers a chance of overcoming the malady.

The prevention of these purulent deposits, however, must be our great aim, and in this I believe much may be done by frequent renewal of dressings, and making in all cases openings for the escape of matter. The removal of patients likely to be seized with the affection from crowded wards to private airy rooms, is a powerful prophylactic means, and in seasons when purulent absorptions seem rife, as they sometimes do, should never be neglected by the hospital surgeon. They sometimes follow rapidly upon the employment of debilitating remedies, and the early use of a good diet after operations and severe injuries, and abstaining from all depletory treatment when pus is freely secreted, or even when about to form, and the liberal use of quinia or other tonics, appears also to have a good effect in preventing them.

Constitutional treatment.—Although in the majority of cases the constitutional treatment of compound fractures is simple, yet too much attention cannot be directed to it, and the greater success of one surgeon over another in the treatment of them in a great measure depends upon the attention paid to the general treatment. When the accident is severe, the fever following it is often considerable and apparently calling for bloodletting, though experience shows that where this is carried to any extent they rarely do well. This is indeed what might have been expected, the system having received a severe shock by the injury, which will require all its energies, and at times all the support that can be given to it, to aid in the process of restoration. Diaphoretics, such as the neutral or effervescent mixture, sweet spirits of nitre, small doses of Dover's powder, etc., combined with tepid spongings of the surface of the body, and local bloodletting where determinations to particular organs occur, will in general be found all-sufficient in the treatment.

When cathartics are demanded, such should be chosen as produce their full effect speedily, in order that the patient need not be often disturbed by their operation, which always, even when fracture-beds are made use of, is attended with more or less disturbance of the fractured extremity. During the treatment, repeated purging is to be avoided: daily stools are not necessary to the comfort of the patient, though costiveness is to be avoided, and this end may generally be attained by attention to diet alone; where, however, we fail by this means, the use of laxative enemata, as occasioning less disturbance of the body, will be preferable to the internal use of medicine. Sir A. Cooper asserts, that he has often seen patients destroyed by the frequent administration of purges in compound fractures.[1]

Anodynes.—Great benefit will be found to follow the free use of anodynes immediately after the occurrence of the accident, and their continuance, as well for the purpose of procuring sleep as of assuaging pain and quieting the mind, is always proper. Long observation in hospitals has so convinced me of the beneficial effects of anodynes after severe injuries, that I cannot too strongly recommend their judicious employment. No theoretical considerations should interfere with their use, and when fever is present, they may be beneficially combined with diaphoretics. Strict attention to cleanliness and proper ventilation of the apartment are highly important in these accidents, and benefit is often derived from sending the patient into the open air on a wheeled chair, or other appropriate conveyance, with the limb properly supported by splints or other apparatus, in the after stages of the treatment, particularly where the appetite is languishing, or the general health is in any way suffering from confinement. As after other severe injuries, very great improvement in the constitutional symptoms will be found to follow attention to the state of the skin and secretions. Where the tongue is furred, and the secretory organs sluggish in their functions, small portions of blue mass, or hydrargyri cum creta, may be sometimes advantageously employed, and careful sponging of the injured limb or of the whole body, where the skin is harsh and dry, is both beneficial and comforting to the sufferer.

Diet.—When the inflammatory symptoms which set in after compound fractures have subsided, a good diet with animal food of easy digestion is proper, and where a large discharge of pus from the wound or hectic symptoms supervene, a full and nourishing one, with porter, wine, or other stimulus, should be allowed. The influence of low living upon the parts interested in compound fractures has been noticed by all surgeons, and the improvement as well in the local as the general symptoms, produced by an augmented diet and the allowance of a stimulant, have been often observed.

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[1] On Fractures and Dislocations, 1842, p. 266.

Long continuance in the supine position oftentimes exerts a decidedly bad effect upon the system. In elderly persons, or those loaded with fat, it gives rise, as has been already noticed, to excoriations and ulceration, and even in robust individuals it has been thought with some show of reason to favor the occurrence of engorgements, inflammations, and deposits of pus in the thoracic viscera. These ill consequences may be obviated, and the sufferer in every way much comforted after the inflammatory period has passed, by daily elevating the trunk with the aid of pillows, or a bed chair, at the same time taking proper precautions to prevent any disturbance of the extremity.

Period of union.—Under favorable circumstances consolidation occurs to such a degree as to permit of the employment of crutches after compound fracture, from two to four months, though a long time sometimes elapses after this, however well the limb may have been treated, before much weight can be borne upon it. In many cases the consolidation is retarded long after the time mentioned by the presence of extraneous bodies, or of necrosed portions of bone. Where these exist, cicatrization of the wound is delayed, or if this has become closed, fistulous openings are formed conducting to the foreign body.

The existence of diseased bone becoming loose may very generally be suspected from the appearance of the soft parts around the wound alone, fungous growths being observed to shoot out luxuriantly from it, and a disposition noticed in the surrounding parts to inflame or slough, at the same time that the discharge becomes thinner and more fetid. The exfoliation of bone it was formerly thought might be hastened by various topical applications, but practical men have long since been convinced of their inutility. When it becomes evident that a portion of bone must exfoliate, the mildest dressings combined with attention to cleanliness and the state of the digestive functions, and occasional moderate handling of the dead part by means of *the* forceps or probe, with a view of gently exciting the vessels engaged in the process of removal, is all that is demanded in the treatment. We must wait patiently till the necrosed portion is loosened, and as soon as this happens its removal is to be effected, after which the openings usually close up and consolidation rapidly advances. In one of the last cases of this kind which I saw at the Pennsylvania Hospital, I removed in the month of March two inches of the necrosed shaft of the femur where firm union was evidently delayed by it. The accident had happened three months previously, and the patient, whose wound had cicatrized with the exception of a small fistulous orifice leading to the bone, had a most excellent limb. As soon as the necrosed piece was found to have become loose, I cut down upon and removed it, and the treatment with the straight splints, which were used on the occasion, was continued. One month after this was done the wound had closed and the bone united, and about the middle of June the patient was discharged, walking well with a firm and good limb.

Sometimes pieces become detached, but cannot readily be seized with the forceps, and here the introduction of a seton has been recommended, more particularly in gunshot fractures, to hasten their removal, but as its introduction is painful, and not unfrequently gives rise to erysipelas, the careful use of the knife and forceps is always a preferable means. In all these cases, if union has not occurred the extremity is to be as carefully attended to, in regard to position and support, as in the early stages of the treatment. Where the portions of bone are not yet loose, and the bond of union is sufficiently advanced to permit of its employment, benefit will at times be found to arise from allowing moderate use of the limb, as by this means the general health is improved, the action of the capillaries and absorbents increased, and exfoliation of dead bone greatly hastened.

Cases requiring secondary amputation.—Despite the employment of the most cautious judgment in determining upon the cases of compound fractures in which attempts are proper to save a limb, or of all the care which even those most thoroughly versed in the treatment of these accidents can give to them, instances often occur, particularly in hospital practice, where amputation is ultimately demanded. This step may become necessary very soon after the accident from the occurrence of gangrene, and where this takes place a question has arisen, whether we are to amputate on its appearance, or are to wait till its progress be arrested, and a well-defined line of separation formed between the living and mortified parts. This important question is well settled in cases of mortification arising from ossification of the arteries and hospital gangrene, as well as in that following upon constitutional causes, the rule in these being imperative, to wait for the formation of this line, and were it not followed, the cause still being present, the disease would continue steadily progressive in the stump. In traumatic gangrene, however, the opinions of practitioners are still much divided. Curtis[1] and Kirkland[2] long since advocated the propriety of amputating in these cases during the progress of the gangrene. Larrey, who first laid down the division of gangrene into traumatic and spontaneous, states, that where mortification results from a mechanical cause and endangers life, we need not wait until the disorder has ceased to spread,[3] and the more recent extensive experience of Lawrence,[4] Hutchison,[5] Hennen, and a host of others, principally military surgeons, seems to confirm the propriety of it. These writers, indeed, affirm that traumatic gangrene, instead of contra-indicating the operation, rather urgently demands it; the affection arising from a local injury in a healthy constitution rendering it more than likely that amelioration of all the symptoms will follow the removal of their local cause. Mr. Guthrie, who advocates the same practice, urges forcibly the necessity of amputating above or at the point of injury, without waiting for a line of separation in cases of recent injury to the main artery or vein of a limb where mortification follows, and in gangrene of a like kind, which sometimes ensues upon the ligature of large vessels for the cure of aneurisms, or suppression of hemorrhages, many surgeons incline to a similar practice. Mr. Pott, whose experience in the class of accidents we are treating of was great, advised that amputation should never be done till nature has separated the diseased from the sound part, and stated that he had never once seen the experiment succeed; and one of our recent writers, Sir Wm. Fergusson, who was educated in the doctrines which teach the propriety of amputation in spreading gangrene, and was strongly prepossessed in its favor, says, that after having acted on and seen others repeatedly do the same, he feels bound to say that the success has been very different from what he anticipated. In six of his own cases in which he operated, none succeeded. I have always myself waited for a line of demarcation, and as yet have seen nothing that would lead me to deviate from this practice. When amputation is determined upon in spreading gangrene, it should be performed without any delay, and as soon as the first symptoms of it become evident, as the constitutional symptoms to which it gives rise hourly augment in severity, and become more exhausting to the patient. The incisions, too, should be made in a sound part, where the skin is free from all discoloration, and when it can be done, a joint had better be interposed between the affected part and the point of incision. The operation, however, should never be practised without reference to the general symptoms, and, in a state of extreme prostration attended with infiltration of the soft parts above the seat of injury, tension of the abdomen, diarrhœa, delirium, or what experience has taught me to regard as a highly unfavorable symptom, a jaundiced tint, it should not be attempted. Mr. Porter of Dublin,[1] who is favorable to the practice and has given to the profession some highly interesting observations upon it, states that he is not aware of an instance proving fortunate where the system had previously been materially engaged, and in his more recent work on aneurism, has remarked that amputation in spreading grangrene "still requires the sanction of further experience before it will be universally accepted."

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[1] Diseases of India, p. 229.

[2] Medical Surgery, vol. ii. p. 380.

[3] Military Surgery, vol. ii.

[4] Med. Chirurg. Transacts., vol. vi.

[5] Practical Observations, p. 70.

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[1] Dublin Journ., vol. iv. p. 222.

Hemorrhage.—This may occur from various causes, and at very varying periods. Where the wound has been caused by direct force, and is accompanied with severe contusion, the separation of the sloughs which necessarily follows such a state, sometimes gives rise to hemorrhage. Where this is venous, or proceeds from small and superficial vessels, it is attended with but little danger, being easily repressed by the application of dry lint or charpie to the part, accompanied or not by elevation of the limb, but where the blood poured out is from an artery of any magnitude, and is deep seated, or the wound is in a state of high inflammation, much difficulty will be found in arresting it; here pressure cannot be borne, the vessel if it be raised on a tenaculum, which oftentimes cannot be done, will not hold a ligature, or if this can be applied, will ulcerate after a short period and give rise to a renewal of the bleeding. Another cause of secondary hemorrhage is the pressure of a fragment of bone upon an adjoining artery, causing its ulceration. Bleeding from this cause, though much more rare, is of a more alarming kind than that just alluded to, the vessels opened being mostly of large size, and occurs at a later period than that which succeeds the separation of sloughs. Pelletan[1] reports a case in which pressure of a displaced fragment of bone upon the anterior tibial artery caused hemorrhage so late as the seventy-fifth day to such an extent as to necessitate amputation.

In both of these classes of cases, if the general and local symptoms be good, an effort to save the limb by securing the main artery is justifiable, but where the wound presents a bad aspect, or the patient is much exhausted, amputation must be at once resorted to. Hemorrhage from whatever cause is always an alarming occurrence to the patient, and in its treatment it is of much importance to give attention to his state of mind, he should be soothed and encouraged at the same time that anodynes are freely administered to produce a state of tranquillity and bodily rest. Where bleeding has once occurred and decided means are not at once employed to prevent its recurrence, the patient should be frequently visited by his surgeon, and closely watched by a reliable attendant. The dressings on the limb should be light, and great care taken to prevent any change of position.

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[1] Clinique Chirurgicale, tom. ii. p. 142.

Amputation may also become necessary secondarily *where large joints become opened by ulceration, or where life is endangered by profuse discharge and hectic, or in consequence of non-union of the bones.*

Despite every attention the suppuration sometimes increases in quantity and becomes irritating and offensive, the wound puts on a bad appearance, the granulations presenting a sickly hue, being large and œdematous, the fractured fragments become denuded of their periosteum, of a yellowish color, or if the injury be near to an articulation, the ends of the bones become softened and carious, and the capsular ligament ulcerates; at the same time the constitution is sympathetically affected, the tongue grows dry and dark, the appetite fails, diarrhœa, profuse sweats, and hectic set in, and if the extremity be not then removed, death usually is not slow to follow. Profuse suppuration alone, unaccompanied by caries or necrosis of the bones, rarely gives rise to a necessity for amputation.

Though the reunion of bone is considerably retarded by long suppuration, yet the occurrence of *false joint* is not more common after compound than simple fractures. When this state does occur, a glance at its causes, as well as experience, will show that amputation in the generality of cases is our only resource. Malposition of the fragments, the loss of large portions of the bone, and more than all, the presence of foreign matters, are the common local causes of it. The observations of Hennen in regard to appearances on dissection in non-union after compound fractures are valuable. After stating that he had not had many opportunities of examining very recent cases, his experience having been chiefly confined to those of long-standing, he observes: "In the remainder of about fifty cases (two being excepted) that I have examined myself or been present at the examination of, and thirty examined by gentlemen in whom I place the highest confidence, more or less of disease was observable in the bones, exclusive of the solution of continuity effected in them. The appearances, which were sometimes separate, but much oftener combined, were generally as follows: Roughness of the extremities of the fracture, denudation of the sides of the bones, and worm-eaten absorption of them; inflammation and ulceration; exfoliations of various sizes, and of different stages of looseness on the extremities of the fractured ends, but not often including the *whole circle;* the same on the sides of the bones in the vicinity of the fracture; the same at a distance from the fracture, but not continuous with it; a line of separation between the bone and its epiphysis or processes very evidently marked, and of a vascular appearance (this last appearance I have seen only at the ends of the bone furthest from the source of circulation; and in such cases, abscesses were formed over the diseased points); loss of the cancelli in the medullary cavities of the bones, with destruction of the medulla itself, or conversion of it into an offensive bloody ichor filling almost the entire canal; loss of the cancelli, with a bloody fungus filling the medullary canal like a stopper or tompion; loose adhesion of the muscles to the bones, to such an extent that separation could be effected by the handle of a scalpel or by the finger, the whole neighborhood of the fractured bone of a greasy unhealthy appearance; and finally, necrosis or complete death of the bone, with deposition of new osseous matter, the deposition being irregular and evidently unhealthy, distorting the limb to a great degree."[1]

Cases are occasionally met with in which, from the neglect of the treatment, imprudence on the part of the patient, or impossibility to retain the bone in its proper place, the extremity of the upper fragment protrudes from the wound at various intervals after the accident, and in these cases, reduction is often impossible or impracticable to maintain, or the end of the bone is necrosed. In instances of this kind amputation has been often done, but where the general symptoms are good, and the wound otherwise is of good aspect, a mere difficulty in reducing the bones is no sufficient reason for it; resection should be resorted to, and the bone properly reduced. If exfoliation be waited for, a long time is necessarily required, previous to which the patient may become exhausted by long-continued irritation and suppuration, or if these did not occur, callus might be thrown out to such an extent around the parts, as firmly to consolidate the limb in the deformed position in which it would necessarily be placed by the protrusion. Numerous cases might be cited to show the safety and beneficial results attendant upon the resection of the protruded ends in these cases. A few examples it may not be amiss here to refer to. In a fracture of the upper part of the humerus seen by Sylvestre on the eighteenth day, one of the ends of the bone protruded an inch, and the other to the extent of half an inch. Repeated attempts at reduction had been made during that time and failed. Sylvestre enlarged the opening, and made applications to the ends of the bone, with a view of hastening their exfoliation; the superior one was after a time thrown off, and, the inferior still being firmly attached to the shaft, he resected it and placed the ends in apposition, surrounding them by proper splints. Fifteen days after the operation the openings cicatrized, and in two months the fracture was consolidated.[1]

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[1] Military Surgery, 3d ed., Lond., p. 125.

In 1815 M. Belair resected half an inch of the superior fragment of a humerus denuded of its periosteum, which had been fractured twenty days previously and protruded. The patient recovered.[2] In a case of transverse fracture of the tibia below its middle, Dr. Shipman resected its protruding end, on the twentieth day, with success.[3] In a case reported by Mr. Peake, a like operation was done upon the leg, three months after the accident, successfully,[4] and in a compound fracture of the femur, treated by Mr. Davidson, an inch of the upper shaft, which protruded through the wound, was sawed off thirty-eight days after the receipt of the injury, and the limb saved.

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[1] Ancien Journ. de Méd., tom. xxxix. p. 275.

[2] Velpeau, Méd. Operat., tom. ii.

[3] Amer. Journ. Med. Sci., vol. iii. N. S.

[4] Edin. Med. and Surg. Journ., vol. ii. p. 94.

Anchylosis, both true and false, sometimes follows the treatment of fractures. The first, or bony anchylosis, is rarely seen, and can only arise where the fracture either affects a joint, or has occurred in its immediate vicinity, in which cases the osseous matter thrown out is sometimes in such large quantity as more or less completely to surround and firmly unite the articulating extremities. False anchylosis is produced by the diminished secretion of synovia, and rigidity in the muscles, ligaments, and other soft parts about the joints, consequent upon the long-continued application of the apparatus employed, with the limb in the same position, and necessarily occurs, to a greater or less degree, after the treatment of fractures, even when these are situated at a distance from the joints. During the treatment much may be done to prevent the occurrence of false anchylosis by the careful employment of some degree of passive motion at the joint every second or third day, and, after its consolidation, the use of frictions, the warm douche, or fomentations combined with gentle exercise, will materially aid in the removal of the stiffness still remaining.

As has been mentioned, it commonly happens where complete necrosis of a portion of the fractured bone occurs, that the sequestrum becomes loose, and is either soon thrown off, or is easily removed with forceps; sometimes, however, in young and robust patients, where the separation is long in being effected, so much callus may be deposited as completely to surround these portions, and though the limb becomes sufficiently firm to allow of some use, a continual discharge and irritation is kept up. In cases of this kind the callus is usually irregular in form and in great abundance, and the extremity is more or less deformed and shortened; all means to heal up the fistulous openings fail, and the introduction of a probe usually conducts at once to the dead bone. Where the sequestrum is so surrounded by callus as to prevent its removal through the openings which exist in the new case, and it is ascertained to be completely loose, recourse should be had to operative means for the purpose of removing it.

To effect this, the osseous shell is to be exposed, and a portion of it sufficient to allow of its easy extraction removed either by the application of a trephine or saw, after which the sides of the wound are to be drawn together, and immediate union encouraged.

A case, showing strikingly the bad effects of allowing these portions of bone to remain, has been reported from the Haslar Hospital.[1] After a compound fracture of a femur, union sufficiently firm to allow of free use of the limb occurred, yet necrosis was present and portions of the bone were occasionally discharged through the openings which still existed. In this state, while the patient was mounting a ladder, very profuse hemorrhage took place in consequence of pressure of a portion of the bone upon the femoral artery, and necessitated the application of a ligature to that vessel.

In the cases of necrosis in which extraction of the sequestrum is impossible, as also in such of these accidents as are followed by caries, diseased joints, deformed and atrophied limbs, and those subject to constant ulcerations, etc., amputation is sometimes demanded by the patient, and in every such instance the surgeon must determine by a careful examination of each individual case, whether the extent of disease, pain, incapacity for business, and inconvenience suffered, are sufficient to call for a resort to this extreme measure. He is to remember that amputation is always a serious operation, and that when performed "par complaisance," it is peculiarly noted for its fatality; besides which the remote effects of the loss of a limb, in the great majority of instances, among the laboring classes of the community—the intemperate, beggared, and helpless situation to which those who submit to it so often sink—afford another, and to the philanthropic surgeon, a strong argument for the utmost caution in recommending amputation. Notwithstanding this, however, and the truth admitted by all, that to save one limb is infinitely more honorable to the surgeon than to have performed numerous successful amputations, still the quaint remark, that "it is better to live with three limbs than die with four," must never be forgotten by him.

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[1] Med.-Chirurg. Rev., vol. viii., 1814.

STATISTICAL ACCOUNT OF THE CASES OF AMPUTATION PERFORMED AT THE PENNSYLVANIA HOSPITAL FROM JAN. 1, 1850, TO JAN. 1, 1860,

WITH A GENERAL SUMMARY OF THE MORTALITY FOLLOWING THIS OPERATION IN THAT INSTITUTION FOR THIRTY YEARS.

IN the 22d, 26th, and 28th volumes of the *American Journal of the Medical Sciences*, I published statistical tables of all of the capital amputations performed at the Pennsylvania Hospital during the twenty years from January, 1830, to January, 1850, with the view of showing the mortality following these operations. I now give a continuation of these statistical tables carried on for another ten years, viz., to January, 1860, drawn up in a manner similar to those already published, with a summary appended of the thirty years' experience of our Institution in this class of cases.

In the tables, all amputations in which the operation was performed within twenty-four hours after the occurrence of the accident are included under the head of immediate, and the cases treated of this class were generally of the most desperate kind, resulting from railroad accidents, machinery, etc., where the soft parts were as seriously injured as the bones.

No.	Admission.	Name.	Age.	Disease or injury.	Part amputated.	Immediate or otherwise.	Result.	Period of discharg or death.
	1850.							
1	January 4th	Thomas Benckert	8	Compound and comminuted fract. of leg	Leg	Immediate	Cured	Feb. 14th, 1850.
2	Feb. 6th	William Bull	10	Compound fracture of legs	Leg	Immediate	Cured	July 11th, 1850.
3	Feb. 14th	Hugh Darcy	28	Compound fracture of forearm	Forearm	......	Cured	June 5th, 1850.
4	March 31st	Joseph Williams, col.	21	Gunshot wound of hand	Forearm	Immediate	Cured	May 16th, 1850.
5	April 4th	Robert McManus	14	Compound fracture of forearm	Forearm	Immediate	Cured	June 6th, 1850.
6	April 9th	Samuel Ennis	15	Compound fracture of forearm	Arm	Immediate	Cured	June 20th, 1850.
7	April 25th	Jacob Fusz	27	Compound fract. of leg, hand, and face	Leg	Immediate	Died	May 3d, 1850.
8	April 19th	Frank Aiken	20	Gunshot wound of knee	Thigh	......	Cured	Aug. 8th, 1850.
9	April 30th	James Fleet	32	Compound fracture of arm	Shoulder-joint	Immediate	Cured	July 27th, 1850.
10	May 8th	Edmund B. Lermond	42	Gangrene of leg	Thigh	......	Died	May 13th, 1850.
11	June 10th	Samuel Budd	19	Compound fracture thigh and fract. leg	Thigh	Immediate	Cured	Aug. 1st, 1850.
12	July 9th	Wm. John Pollock	11	Compound fracture of leg	Thigh	Immediate	Cured	Nov. 30th, 1850.
13	July 12th	R. J. Hunter	36	Compound and comminuted fract. ankle	Leg	Immediate	Cured	Aug. 31st, 1850.
14	August 7th	George Stockbine	19	Compound fracture of humerus	Arm	Immediate	Cured	Oct. 18th, 1850.
15	August 15th	William Maher	19	Compound fracture of forearm	Forearm	Immediate	Cured	Sept. 23d, 1850.
16	August 16th	Samuel Johnson, col.	13	Compound fract. of forearm and elbow	Arm	Immediate	Cured	
17	August 26th	Joshua Myer	23	Compound fracture of forearm	Forearm	Immediate	Cured	Oct. 7th, 1850.
18	Sept. 17th	Hugh Higgins	28	Compound fracture of hand	Forearm	Immediate	Cured	Oct. 23d, 1850.
19	October 9th	William Roun	18	Compound fracture of leg	Leg	Immediate	Cured	Nov. 18th, 1850.
20	October 13th	Joseph Rambo	21	Compound fracture of arm and forearm	Arm	Immediate	Cured	Jan. 31st, 1851.
21	Nov. 10th	Dennis Muldoun	9	Compound fracture of foot	Partial of foot	......	Cured	Jan. 1st, 1851.
22	Nov. 30th	Matthew McDonough	11	Compound fracture of leg	Thigh	Immediate	Cured	June 5th, 1851.
23	Dec. 3d	William Mitchell	47	Compound fracture of leg	Leg	Immediate	Died	Dec. 21st, 1850.
	1851.							
24	Jan. 14th	Charles I. Hare	24	Comp. dislocated elbow and lacer. arm	Arm	Immediate	Cured	Feb. 25th, 1851.
25	January 9th	William Carr	13	Ulcerated and necrosed leg	Thigh	......	Cured	June 23d, 1851.
26	Jan. 24th	Henry Perkins	68	Comp. frac. and lacer. hand and wrist	Forearm	Immediate	Died	Jan. 26th, 1851.
27	Feb. 12th	William H. Lenoir	8	Gangrene of foot from laceration	Leg	......	Cured	May 12th, 1851.
28	March 14th	Edward Duffy, col'd	54	Comminuted fracture of foot	Leg	Immediate	Died	March 21st, 1851.
29	March 19th	Thomas Kennedy	17	Lacerated and fractured hand	Forearm	Immediate	Cured	May 17th, 1851.
30	April 1st	Robert J. Christy	10	Compound fracture of foot and leg	Leg	Immediate	Cured	June 23d, 1851.
31	May 31st	Joseph Osler	34	Compound fracture of hand and forearm	Forearm	Immediate	Cured	July 12th, 1851.

No.	Admission.	Name.	Age.	Disease or injury.	Part amputated.	Immediate or otherwise.	Result.	Period of discharge or death.
	1851.							
32	July 14th	John M. Hasser	11	Compound and comminuted fract. of leg	Thigh	Immediate	By friends cured afterwards	July 16th, 1851.
33	August 4th	Matthew Shay	41	Compound fracture of foot	Leg	Immediate	Cured	Oct. 10th, 1851.
34	August 29th	Patrick McAdam	29	Compound and comminuted fract. of leg	Leg	Immediate	Cured	Oct. 20th, 1851.
	1852.							
35	Jan. 16th	James Nickson	21	Compound and comminuted fract. of foot	Leg	Immediate	Cured	May 28th, 1852.
36	Jan. 16th	James Kidney	19	Compound and comminuted fract. of foot	Leg	Immediate	Cured	May 28th, 1852.
37	January 1st	Thomas Cunington	62	Gangrene of foot (from frost)	Leg	......	Cured	March 25th, 1852.
38	January 23d	John Holland, col'd	30	Gangrene of foot (from frost)	Leg	......	Cured	Feb. 28th, 1852.
39	Feb. 4th	Robert Hood	28	Mortification of foot following burn	Leg	......	Cured, and for misconduct	July 27th, 1852.
40	Feb. 7th	Jno. B. Ferguson, col.	22	Gangrene of foot (from frost)	Leg	......	Died	March 4th, 1852.
41	March 5th	John Kehoe	...	Compound and comminuted fract. of leg	Leg	Immediate	Died	March 5th, 1852.
42	March 18th	Charles May, col'd	25	Compound fracture of hand and wrist	Forearm	Immediate	Cured	May 18th, 1852.
43	March 13th	Jeremiah Thompson	22	Secondary hemorrhage after gunshot fracture of the hand	Arm	......	Died	March 27th, 1852.
44	April 9th	William Gilchrist	26	Lacerated wound of wrist and hand	Forearm	Immediate	Cured	May 10th, 1852.
45	April 12th	Washington Hallman	22	Comp. and comm. fract. of feet and ankles, with fract. femur left side	Legs	Immediate	Cured	June 5th, 1852.
46	April 12th	Thomas Brown	21	Compound fracture and lacerated leg	Leg	Immediate	Cured	August 2d, 1852.
47	May 15th	Adam Fopless	49	Necrosis of the tibia	Leg	......	Died	May 23d, 1852.
48	May 16th	William Ward	21	Compound fracture and lacerated leg	Thigh	Immediate	Died	May 16th, 1852.
49	May 18th	Isaac Dougherty	24	Compound and comm. fract. of forearm	Forearm	Immediate	Cured	August 2d, 1852.
50	May 25th	John Tyghe	19	Compound fracture of arm and forearm	Arm	Immediate	Cured	June 25th, 1852.
51	June 14th	William McCann	40	Compound fracture of humerus	Arm	Immediate	Cured	August 2d, 1852.
52	June 18th	John Weldy	23	Compound fracture of leg and os calcis	Leg	Immediate	Cured	Aug. 30th, 1852.
53	Jan. 30th	John Bartleson	19	Necrosis of forearm	Forearm	......	Cured	Aug. 30th, 1852.
54	July 29th	John Brown	32	Compound fracture of legs and hand	Leg	Immediate	Died	July 29th, 1852.
55	Sept. 9th	John Hudson	18	Compound fracture of forearm (gunshot)	Arm	Immediate	Cured	Nov. 1st, 1852.
56	Sept. 25th	Henry Adair	22	Compound fracture of forearm	Arm	Immediate	Cured	Dec. 20th, 1852.

No.	Admission.	Name.	Age	Disease or injury.	Part amputated.	Immediate or otherwise.	Result.	Period of discharge or death.
	1852.							
57	October 5th	Thomas Powers	41	Compound fracture of forearm . .	Forearm	Immediate	Cured	Dec. 6th, 1852.
58	October 12th	M. Scott	16	Shattered hand	Forearm	Immediate	Cured	Nov. 13th, 1852.
59	Nov. 20th	Charles Murray, col'd	26	Hand torn off by machinery . .	Forearm	Immediate	Cured	Dec. 20th, 1852.
60	Nov. 22d	Isaac Jones	14	Compound fractures of arm and forearm	Arm	Immediate	Cured	Jan. 31st, 1853.
61	Dec. 25th	Stephen Clark	23	Gunshot wound of hand . . .	Forearm	......	Died	Jan. 25th, 1853.
	1853.							
62	April 11th	Charles Lyntz	46	Compound fractures of arm and forearm	Arm	Immediate	Cured	July 28th, 1853.
63	May 16th	John Wooten, Jr.	33	Compound and comm. fract. of forearm	Arm	Immediate	Cured	July 2d, 1853.
64	May 16th	John Kelly	36	Compound fracture of metacarpus, etc.	Wrist-joint	Immediate	Cured	July 11th, 1853.
65	May 21st	John Gallagher	15	Compound fracture of hand . . .	Forearm	Immediate	Cured	July 6th, 1853.
66	June 3d	Matthew Daily	53	Compound fracture of thigh . .	Thigh	Immediate	Cured	Oct. 25th, 1853.
67	June 4th	William Harrison	23	Necrosis of the femur	Thigh	......	Cured	Sept. 8th, 1853.
68	July 26th	William Tate	58	Comp. and comm. fract. metacarpals .	Forearm	Immediate	Cured	Nov. 24th, 1853.
69	August 11th	Robert Warner	25	Lacerated wound	Wrist-joint	Immediate	Cured	Sept. 7th, 1853.
70	August 18th	John M. Justice	42	Gunshot wound of hand . . .	Arm	Immediate	Cured	Sept. 22d, 1853.
71	August 28th	James Conway	40	Comp. fract. of humerus and forearm .	Arm	......	Cured	Oct. 25th, 1853.
72	Sept. 5th	Thomas Kelsh	30	Gunshot wound of hand . . .	Forearm	Immediate	Cured	Sept. 27th, 1853.
73	Sept. 11th	George Rivell	48	Gunshot wound of hand . . .	Forearm	Immediate	Cured	Oct. 9th, 1853.
74	Sept. 15th	Charles Hunter, col'd	21	Comp. and comminuted fract. of arm .	Shoulder-joint	Immediate	Cured	Nov. 14th, 1853.
75	Sept. 1st	James H. Barry	51	Diseased foot	Leg	......	Cured	Nov. 8th, 1853.
76	October 17th	William Vansciver	24	Compound fracture of head of humerus, and lacerations	Shoulder-joint	Immediate	Died	Oct. 24th, 1853.
77	July 26th	William Tate	58	Caries and ulceration of wrist . .	Forearm	......	Cured	Nov. 24th, 1853.
78	July 14th	Hugh Mulholland	27	Fract. femur and severe lacer. wound .	Thigh	......	Cured	Jan. 8th, 1854.
79	Nov. 3d	Peter Lavel	19	Caries and ulceration of foot . .	Leg	......	Cured	Jan. 13th, 1854.
80	Nov. 18th	—— White	15	Hand and wrist torn off . . .	Forearm	Immediate	Cured	Dec. 22d, 1853.
81	Nov. 10th	James Johnson	14	Lacerated wounds of axilla and arm, mortification following	Arm	......	Cured	Feb. 16th, 1854.
82	Nov. 21st	John McCann	29	Hemorrhage from aneurism . . .	Thigh	......	Died	Dec. 11th, 1853.
83	Dec. 17th	Richard Mullon	24	Comp. and comminuted fract. of thigh	Thigh	Immediate	Cured	April 1st, 1854.
	1854.							
4	February 1st	Joseph Barclay	48	Comp. and comminuted fract. of arm .	Arm	Immediate	Cured	June 12th, 1854.

No.	Admission.	Name.	Age.	Disease or injury.	Part amputated.	Immediate or otherwise.	Result.	Period of discharge or death.
	1854.							
85	Feb. 11th	Charles E. Proctor	20	Comp. and comminuted fract. of hand .	Forearm	......	Cured	May 29th, 1854.
86	March 17th	Benjamin Davis	31	Lacerated wound and fractured hand .	Forearm	Immediate	Cured	April 26th, 1854.
87	March 23d	Patrick Dougherty	39	Compound fracture of left arm and comminuted fracture of left hand	Forearm	Immediate	Cured	May 18th, 1854.
88	March 23d	John Weeks	48	Compound and comm. fract. of thigh .	Thigh	......	Died	March 27th, 1854.
89	March 24th	Andrew Newton	29	Arm torn off	Arm	Immediate	Cured	May 31st, 1854.
90	April 6th	Edward Green	20	Compound and comminuted fracture of hand and laceration	Forearm	Immediate	Died	April 9th, 1854.
91	April 7th	Henry Carlin	39	Compound fracture of elbow, forearm, and wrist	Arm	Immediate	Cured	May 18th, 1854.
92	April 18th	Hiram Massey	33	Lacerated and fractured forearm . .	Forearm	Immediate	Cured	May 22d, 1854.
93	May 1 (1853)	William Fodell	21	Diseased knee-joint	Thigh	......	Cured	Aug. 19th, 1854.
94	May 3d	Frederick Elenz	31	Compound fracture of ankle-joint .	Leg	......	Cured	Aug. 24th, 1854.
95	May 19th	Barney O'Neil	24	Caries of knee-joint	Thigh	......	Cured	Oct. 23d, 1854.
96	June 24th	John Luick	27	Compound and comm. frac. of arm .	Shoulder-joint	Immediate	Died	June 25th, 1854.
97	June 24th	G. Washington Myers	17	Caries	Leg	......	Cured	Sept. 26th, 1854.
98	June 29th	Harriet Valentine, c.	19	Diseased knee	Thigh	......	Died	Aug. 8th, 1854.
99	July 22d	Owen McIlwee	27	Comp. and comm. fract. of leg and foot	Leg	......	Died	July 25th, 1854.
100	July 25th	Patrick Hurley	18	Compound fract. of leg and laceration .	Thigh	......	Cured	Dec. 7th, 1854.
101	August 1st	Thomas Keefe	19	Incised wound of ankle-joint . .	Leg	Immediate	Cured	Nov. 13th, 1854.
102	August 22d	John Watmough	19	Burn of hand; mortification after .	Partial of hand	......	Cured	Oct. 19th, 1854.
103	August 24th	James McPeak	23	Secondary hemorrhage after wound of forearm	Arm	......	Cured	Sept. 16th, 1854.
104	August 26th	William Curry	8	Laceration and fractured foot . .	Partial of foot	Immediate	Cured	Feb. 26th, 1855.
105	August 28th	Charles Schaeffer	8	Compound and comminuted fract. leg .	Leg	Immediate	Cured	April 4th, 1855.
106	Sept. 17th	William C. Griffin	20	Gunshot wound of hand . . .	Forearm	Immediate	Cured	Sept. 8th, 1854.
107	Sept. 27th	Lewis Churchill	21	Compound fracture of hand . .	Wrist-joint	Immediate	Cured	Nov. 10th, 1854.
108	October 3d	David Henry	32	Amputated foot	Partial of foot (Chopart's)	Immediate	Cured	Nov. 6th, 1854.
109	Sept. 20th	Levi W. Brown	24	Compound fracture of forearm . .	Arm	......	Cured	Nov. 11th, 1854.
110	Nov. 11th	William Bogan	6	Compound and comminuted fract. leg .	Leg	Immediate	Cured	Dec. 29th, 1854.
111	Nov. 9th	John Anderson	28	Compound and comminuted fract. leg .	Leg	......	Cured	Dec. 21st, 1854.
112	Nov. 11th	Robert Wilson	18	Fracture of knee-joint . . .	Thigh	......	Cured	Feb. 15th, 1855.

No.	Admission.	Name.	Age.	Disease or injury.	Part amputated.	Immediate or otherwise.	Result.	Period of discharge or death.
	1855.							
113	Jan. 10th	Lambert Hard	8	Lacerated wound of hand	Wrist-joint	Immediate	Cured	Feb. 23d, 1855.
114	Feb. 2d	John Hannigan	23	Compound and comm. fract. hand	Forearm	Immediate	Cured	April 13th, 1855.
115	Feb. 23d	Henry McCoy	19	Compound and comm. fract. leg	Thigh	......	Died	March 5th, 1855.
116	March 19th	John McNeal	17	Compound and comm. fract. foot	Leg	Immediate	Died	April 18th, 1855.
117	May 19th	Ezekiel V. Carson	38	Compound fracture of both legs	Leg	Immediate	Died	May 31st, 1855.
118	May 19th	Patrick Lynch	23	Compound fracture of leg	Thigh	......	Died	June 2d, 1855.
119	June 1st	Jacob P. Fetterly	23	Compound fract. of hand and lacer.	Partial of hand	Immediate	Cured	July 19th, 1855.
120	July 5th	James Doyle	35	Compound fracture of leg and foot	Thigh	Immediate	Died	July 27th, 1855.
121	August 7th	Thomas Wright	19	Compound fracture of forearm	Forearm	Immediate	Cured	Oct. 11th, 1855.
122	August 10th	Thomas Holdam	51	Compound and comm. fract. of foot	Leg	......	Died	Aug. 13th. 1855.
123	August 14th	David Clewes	32	Gunshot wound of forearm	Forearm	Immediate	Cured	October 4th 1855.
124	July 25th	George Stouffer	25	Diseased knee	Thigh	......	Died	Sept. 16th, 1855.
125	October 11th	Henry Roth	15	Arm torn off and lacerations	Shoulder-joint	Immediate	Cured	Dec. 11th, 1855.
126	October 14th	James Taggart	24	Compound and comminuted fract. leg	Leg	Immediate	Cured	Jan. 17th, 1856.
127	Nov. 17th	Isaac Mullen	29	Caries of bones of foot	Leg	......	Cured	Jan. 8th, 1856.
128	Nov. 30th	Charles H. McMullen	11	Comm. fract. and lacerations of foot and leg, and lacer. of opposite foot	Leg	Immediate	Died	Dec. 14th, 1856.
	1856.							
129	January 7th	Sarah Busch	45	Compound and comm. fract. ankle	Leg	Immediate	Died	Jan. 17th, 1856.
130	Jan. 15th	Samuel Stackpole	23	Compound and comm. fract. arm	Arm	Immediate	Cured	March 8th, 1856.
131	Nov. 6 (1855)	James King	35	Osteo-sarcoma of thigh	Thigh	......	Died	June 3d, 1856.
132	March 20th	Charles Y. Preston	22	Compound and comm. fract. of forearm	Forearm	Immediate	Cured	June 5th, 1856.
133	April 11th	Thomas Kett	15	Lacerated hand	Wrist-joint	Immediate	Cured	June 4th, 1856.
134	June 9th	Patrick O'Neall	39	Compound fracture of foot—crushed	Leg	Immediate	Died	June 22d, 1856.
135	April 29th	Alexander Laidlaw	22	Comminuted fracture of arm	Arm	......	Cured	Aug. 7th, 1856.
136	May 17th	William Chapman	40	Caries of knee-joint	Thigh	......	Cured	Sept. 1st, 1856.
137	July 4th	Charles De Boos	15	Shattered hand	Wrist-joint	Immediate	Cured	Aug. 11th, 1856.
138	Dec. 12(1855)	Samuel Kempner	22	Gunshot wound of thigh; gangrene following lig. of popliteal for hemorr.	Leg	......	Cured	Aug. 21st, 1856.
139	July 17th	James Mahoney	15	Compound and comm. fract. leg	Leg	Immediate	Cured	Nov. 13th, 1856.
140	June 24th	James Mars	35	Caries of foot and ankle	Leg	......	Cured	Oct. 20th, 1856.
141	August 3d	James McGarry	21	Crushed hand and wrist	Forearm	Immediate	Died	Aug. 24th, 1856.

No.	Admission.	Name.	Age	Disease or injury.	Part amputated.	Immediate or otherwise.	Result.	Period of discharge or death.
	1856.							
142	July 17th	Thomas Rose	22	Fract. thigh and comp. fract. both legs	Thigh	......	Died	August —, 1856.
143	Jan. 28th	James Milligan	16	Lacerated hand and forearm . .	Forearm	......	Cured	October 9th, 1856.
144	July 28th	David McLaughlin	25	Compound and comm. fracture forearm	Forearm	Immediate	Cured	Sept. 17th, 1856.
145	August 5th	James McDonald	38	Compound and comm. fracture of leg .	Leg	Immediate	Died	Aug. 12th, 1856.
146	August 24th	Alexander McAllister	17	Shattered hand	Wrist-joint	Immediate	Cured	Oct. 6th, 1856.
147	August 30th	John Graham	33	Amputated forearm	Forearm	Immediate	Cured	Oct. 9th, 1856.
148	Sept. 7th	Hugh Gormley	36	Popliteal aneurism and gang. sac. .	Thigh	......	Died	Oct. 25th, 1856.
149	Sept. 7th	Peter Rementer	21	Gunshot wound of knee-joint . .	Thigh	Immediate	Died	Oct. 29th, 1856.
150	Sept. 23d	Miles Ward	28	Comminuted and compound fract. foot	Leg	Immediate	Cured	Nov. 10th, 1856.
151	Sept. 26th	Michael Hanhoff	22	Gunshot wound of arm . . .	Arm	Immediate	Died	Oct. 30th, 1856.
152	Sept. 27th	Edward McGraw	14	Comp. and comm. fract. forearm and arm	Arm	Immediate	Cured	Nov. 20th, 1856.
153	August 21st	Eliza Clark	23	Osteoid tumor of leg	Leg	......	Died	Oct. 31st, 1856.
154	October 20th	Robert Thornton	43	Shattered hand and forearm . .	Forearm	Immediate	Cured	Dec. 18th, 1856.
155	October 20th	John Joyce	39	Leg cut off by railroad . . .	Thigh	......	Cured	Dec. 20th, 1856.
156	Nov. 1st	James Barry	31	Conical and ulcerated stump . .	Thigh	......	Cured	Feb. 11th, 1857.
157	Dec. 3d	John Hawthorn	23	Crushed foot	Leg	Immediate	Cured	April 4th, 1857.
158	Dec. 23d	Geo. Nickerson, col'd	33	Gunshot fracture of femur . . .	Thigh	......	Died	Jan. 17th, 1857.
159	Dec. 24th	Thomas Ely, col'd	68	Crushed foot	Leg	Immediate	Died	Dec. 26th, 1856.
	1857.							
160	Jan. 6th	Chas. Supphay, col'd	49	Frozen feet	Leg	......	Died	Feb. 16th, 1857.
161	Jan. 14th	William Wark	40	Gunshot wound of forearm . . .	Forearm	Immediate	Cured	Feb. 27th, 1857.
162	Nov. 17(1856)	Susan Lundy	51	Diseased knee	Thigh	......	Cured	July 27th, 1857.
163	February 3d	Daniel Rogers	35	Compound and comminuted fract. leg .	Thigh	......	Cured	July 9th, 1857.
164	March 17th	John Carey	30	Frosted feet	Partial of foot	......	Cured	May 14th, 1857.
165	March 10th	Joseph Buiorton	38	Frosted feet	Partial of foot	......	Cured	Oct. 15th, 1857.
166	April 22d	James Stackhouse	21	Compound and comminuted fract. foot	Leg	Immediate	Cured	July 11th, 1857.
167	April 23d	George W. Maurice	28	Crushed hand and forearm . .	Arm	Immediate	Cured	June 6th, 1857.
168	April 24th	Charles Wilson	16	Caries of knee and deformed limb .	Thigh	......	Cured	July 30th, 1857.
169	June 1st	William Thomas	39	Compound fracture of thigh . .	Thigh	Immediate	Cured	July 20th, 1857.
170	June 8th	William H. Moore	28	Compound dislocation and fract. ankle	Leg	Immediate	Cured	July 16th, 1857.
171	May 30th	John Hutchinson	48	Compound and comm. fracture forearm	Forearm	......	Died	June 18th, 1857.
172	June 29th	Andrew Brinckley, c.	40	Caries of bones of leg	Thigh	......	Cured	Sept. 2d, 1857.

No.	Admission.	Name.	Age.	Disease or injury.	Part amputated.	Immediate or otherwise.	Result.	Period of discharge or death.
	1857.							
173	June 17th	Robert Cliff	26	Crushed foot	Leg	......	Cured	Nov. 5th, 1857.
174	June 26th	Andrew Johnston	30	Caries of knee	Thigh	......	Died	August 7th, 1857.
175	July 24th	Patrick O'Brien	18	Compound fracture of foot	Leg	......	Cured	Sept. 3d, 1857.
176	April 6th	George Bayley	56	Ulcer of leg and foot	Leg	......	Cured	Jan. 2d, 1858.
177	August 2d	Manuel Braceland	35	Compound fracture of elbow	Arm	......	Died	Sept. 1st, 1857.
178	August 20th	John Wilson	18	Compound and comm. fracture forearm	Elbow-joint	Immediate	Cured	Oct. 14th, 1857.
179	August 20th	Patrick McDonough	26	Crushed foot	Leg	Immediate	Cured	Oct. 3d, 1857.
180	August 13th	John McGinley	21	Compound fracture of metatarsus	Leg	......	Died	Sept. 3d, 1857.
181	October 13th	Lewis Bernstein	13	Lacerated wounds of forearm and arm	Arm	Immediate	Cured	Jan. 25th, 1858.
182	October 19th	George Wagner	13	Compound fracture and lacerated arm	Arm	Immediate	Cured	Dec. 7th, 1857.
183	Nov. 19th	Thomas Sharp	11	Compound and comm. fracture of arm	Arm	Immediate	Cured	Dec. 24th, 1857.
184	Nov. 24th	Joseph Caffrey	19	Compound fracture of foot	Partial of foot (Hey's)	Immediate	Cured	Jan. 15th, 1858.
185	Nov. 27th	David Llewellyn	22	Compound fract. of leg and laceration	Leg	......	Cured	March 29th, 1858.
186	Dec. 11th	John Train	60	Cancer of arm and forearm	Arm	......	Cured	April 27th, 1858.
	1858.							
187	January 1st	Michael Deal	26	Hand blown off and lacerated forearm	Forearm	Immediate	Cured	Feb. 12th, 1858.
188	Jan. 15th	Margaret Glenn	58	Caries of the leg	Leg	......	Died	Feb. 1st, 1858.
189	March 21st	Alfred Redman	25	Compound and comm. fracture of leg	Leg	......	Died	March 27th, 1858.
190	March 11th	Thomas McIntire	14	Inflamed leg and ankle	Thigh	......	Cured	June 28th, 1858.
191	May 4th	James McGonegal	48	Amputated leg	Leg	Immediate	Died	May 13th, 1858.
192	May ——	Adam Bauer	18	Gunshot wound of hand	Forearm	Immediate	Cured	June 22d, 1858.
193	May 13th	Thomson Hodson	56	Lacerated hand	Wrist-joint	Immediate	Cured	July 8th, 1858.
194	May 18th	Charles Hughes	12	Lacerated wrist-joint and forearm	Forearm	Immediate	Cured	June 16th, 1858.
195	May 31st	John Walls	14	Forearm torn off	Arm	......	Died	June 11th, 1858.
196	June 3d	Henry Westmond	24	Crushed foot	Leg	Immediate	Died	July 9th, 1858.
197	June 10th	Richard Williams	38	Comp. fracture of forearm and wrist, and lacerated do.	Forearm	Immediate	Cured	Aug. 19th, 1858.
198	June 11th	Edward McDonald	12	Foot torn off	Leg	Immediate	Cured	July 26th, 1858.
199	July 2d	Terence Farley	10	Compound fracture of metatarsus	Partial of foot (Pirogoff)	Immediate	Cured	Dec. 16th, 1858.
200	July 2d	Nicholas Snyder	5	Compound and comm. fract. tarsus	Partial of foot (Pirogoff)	Immediate	Cured	Sept. 16th, 1858.

No.	Admission.	Name.	Age.	Disease or injury.	Part amputated.	Immediate or otherwise.	Result.	Period of discharge or death.
	1858.							
201	August 17th	George Lowber	40	Lacerated forearm	Forearm	Immediate	Cured	Sept. 17th, 1858.
202	August 17th	Thomas H. Snyder	40	Gunshot wound of forearm . . .	Forearm	Immediate	Died	Sept 8th, 1858.
203	Sept. 1st	Fritz Maillardet	5	Fractured thighs	Thigh	Immediate	Died	Sept. 2d, 1858.
204	October 9th	William Myers	28	Crushed foot	Leg	Immediate	Cured	Dec. 14th, 1858.
205	October 14th	George Grant	24	Compound and comm. fract. leg . .	Leg	Immediate	Cured	Dec. 6th, 1858.
206	October 26th	Frederick Trump	15	Arm torn off	Shoulder-joint	Immediate	Cured	Jan. 27th, 1859.
207	October 27th	John Walter	33	Compound fracture humerus (condyles)	Arm	......	Cured	Jan. 8th, 1859.
208	Nov. 13th	Hugh Sinamon	31	Comminuted and compound fract. ankle	Leg	Immediate	Died	Nov. 19th, 1858.
209	Nov. 18th	Thomas Rossiter	7	Compound and comminuted fracture of thigh and lacerations	Thigh	Immediate	Cured	Feb. 14th, 1859.
	1859.							
210	Feb. 5th	George Watson	21	Compound fracture of elbow-joint .	Arm	Immediate	Cured	March 10th, 1859.
211	Feb. 2d	James Berry	56	Cancer of the hand	Forearm	......	Cured	March 28th, 1859.
212	Feb. 11th	Sarah B. Noble	15	Lacerated arm, with division of brachial	Arm	Immediate	Cured	April 18th, 1859.
213	Feb. 22d	Edward McCann	28	Comp. fracture of elbow and laceration	Arm	Immediate	Cured	June 13th, 1859.
214	Feb. 25th	Michael Boyle	33	Compound and comm. fracture of foot .	Thigh	......	Cured	July 23d, 1859.
215	May 3d	Charlotte Dean	64	Necrosis of tibia and diseased knee .	Thigh	......	Died	May 12th, 1859.
216	May 11th	G. W. Dutton	34	Compound dislocation of metacarpus .	Forearm	......	Died	May 23d, 1859.
217	July 5th	Andrew J. Evanson	40	Compound fracture of elbow-joint, and ruptured brachial	Arm	Immediate	Cured	Oct. 3d, 1859.
218	June 20th	James Thornton	40	Laceration and burned hand . .	Forearm	......	Cured	Aug. 6th, 1859.
219	July 15th	Josiah Chapman	21	Compound and comm. fracture of foot .	Leg	Immediate	Died	July 25th, 1859.
220	August 10th	Joseph Adams	16	Comminuted fracture of metacarpus .	Forearm	Immediate	Cured	Sept. 26th, 1859.
221	Sept. 22d	Patrick McCabe	31	Compound and comm. fracture of leg .	Leg	......	Cured	Nov. 17th, 1859.
222	October 3d	Joseph Tudor	27	Crushed hand and wrist . . .	Forearm	Immediate	Cured	Nov. 7th, 1859.
223	October 4th	John Fow	46	Deformed and ulcerated leg . . .	Leg	......	Cured	Feb. 20th, 1860.
224	October 25th	John Kane	24	Crushed foot	Leg	Immediate	Cured	April 11th, 1860.
225	October 24th	John McMullin	18	Crushed foot	Leg	Immediate	Cured	Dec. 8th, 1859.
226	Nov. 7th	William Quigg	9	Lacerated wound of elbow, arm, and forearm	Arm	Immediate	Cured	Jan. 5th, 1860.
227	Nov. 16th	Jeremiah Buchanan	39	Gunshot wound of forearm . . .	Forearm	Immediate	Cured	Dec. 11th, 1860.
228	Nov. 19th	——— Duncan	33	Caries of knee joint	Thigh	......	Cured	Jan. 16th, 1860

From the above table it will be seen that from January, 1850, to January, 1860, there were 228 capital amputations performed. Of these, 173 were cured and 55 died.

Forty-three were of the thigh, seventy of the leg, eight of the feet, six at the shoulder-joint, thirty-eight of the arm, fifty-two of the forearm, eight at the wrist-joint, two of the hand, and one at the elbow-joint.

One hundred and forty-six of the 228 operations were primary, being done for recent injuries within twenty-four hours after the occurrence of the accident, and of these 119 were cured, and 27 died; 42 were secondary, of which 27 were cured, and 15 died; 40 were for the cure of chronic affections, of which 27 were cured and 13 died.

Twenty-five of the whole number in the table were done at the joints, of which 23 were cured and 2 died.

One hundred and seven of the amputations were of the upper extremity, of which 94 were cured and 13 died.

One hundred and twenty-one were of the lower extremity, of which 85 were cured and 36 died.

In adding the results furnished in the above ten years to those given in the volumes of the American Journal already referred to, for the twenty years previously, we arrive at the following results:—

Of 428 amputations upon 424 patients, performed during the thirty years from 1830 to 1860, 321 were cured and 103 died. Of these, 261 were primary, of which 54 died; 83 were secondary, of which 31 died; 84 were for the cure of chronic diseases, of which 18 died.

One hundred and ninety-four of the amputations were of the upper extremity, of which 21 died; 234 were of the lower extremity, of which 74 died; 46 were amputations at the joints, of which 6 died.

One hundred and eighteen of the patients operated on were under 20 years of age, of whom 108 were cured and 10 died; 133 were between 20 and 30, of whom 101 were cured and 32 died; 87 were between 30 and 40, of whom 60 were cured and 27 died; 62 were between 40 and 50, of whom 40 were cured and 22 died; 21 were upwards of 50, of whom 16 were cured and 5 died.

STATISTICS OF THE MORTALITY FOLLOWING THE LIGATURE OF ARTERIES.

THE subjects of aneurism and of hemorrhage are of the highest interest and importance, and are justly pointed to by the surgeon, as well to show the proficiency of his art, as the benefits conferred by it upon the human family. Notwithstanding, however, the great improvements made in the surgical treatment of these affections, the mortality attendant upon the tying of large vessels is still great. Some years since (1845–'49), I published the following tables comprising all the then fully reported cases of ligatures of the subclavian, iliac, carotid, and femoral vessels within my reach, and subjected them to analysis in regard to some of the difficulties of these operations, the mortality following them, mistakes in diagnosis, accidents, and the causes of death. In these tables, as in all such, the actual results are, I have no doubt, less favorable than they appear to be, unfortunate operations being, as is well known, less generally reported than successful ones, and in those recorded, any one who attempts to collect materials of a similar character to those here presented, will have often to lament, that the comparatively unimportant steps of the procedure are given and commented upon with minuteness, while the dangers attendant upon it, the difficulties of diagnosis, and *post-mortem* appearances, are either passed slightingly over, or altogether omitted.

The succeeding table, exhibiting the mortality following the operation of tying the subclavian artery, includes sixty-nine cases, and embraces those in which the ligature was applied below the clavicle, as well as those in which the artery was exposed within the scaleni muscles, either for the arrest of hemorrhage, or for the cure of disease.

I. Mortality following the Operation of

No.	Surgeon.	Sex.	Age.	Right or left side.	Disease.	Duration of disease.	Ligature separated.
1[1]	Keate	M.	25		Aneurism	....	....
2	Ramsden	M.	32	Right side	Aneurism	4 months	....
3	W. Blizard	...	Old	....	Aneurism	....	....
4[2]	Colles	M.	33	Right side	Aneurism	2 months	....
5	Colles	M.	48	Right side	Aneurism	6 weeks	....
6	Chamberlaine	M.	25	Left side	Aneurism from wound	3 months	13th day
7	T. Blizard	M.	47	Left side	Aneurism	1 month	....
8	Post	M.	27	Left side	Aneurism	3 weeks	18th day
9	Wells	M.	61	Right side	Aneurism	7 months	22d day
10	Dupuytren	M.	37	Left side	Aneurism	7 years	15th day
11	Liston	M.	35	Left side	Aneurism	5 months	12th day
12	Mayo	M.	38	Left side	Aneurism	4 months	....
13	Todd	M.	35	Right side	Aneurism	4 months	12th day
14	Key	...	...	....	Aneurism	....	....
15	Gibbs	M.	35	....	Aneurism	....	12th day
16	Travers	M.	73	....	Aneurism	....	....
17	Baroni	M.	...	....	Wounded axillary	Some days after	....
18	Brodie	M.	56	Left side	Aneurism	2 months	....
19	Bullen	M.	60	Right side	Aneurism	4 months	19th day
20	Key	M.	36	Right side	Aneurism	6 weeks	12th day
21	Galtié	M.	...	....	Hemorrhage following compound fracture of superior end of humerus.	....	....
22	Wishart	M.	47	Left side	Aneurism	3 weeks	16th day
23	Arendt	M.	30	Right side	Aneurism	1 month	16th day

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[1] The ligature was here placed below the clavicle.

[2] The ligature was here placed internally to the scalenus muscle.

Tying the Subclavian Artery.

Date of operation.	Result.	Period of death.	Cause of death.	Work.
March, 1800	Cured	....	....	London Med. Rev., vol. vi., 1801.
Nov. 9th, 1809	Died	5th day	Irritation from sloughing of tumor	Practical Observations.
1811	Died	4th day	Not stated	Hodgson on the Arteries.
Oct. 10th, 1811	Died	4th day	Hemorrhage	Edinburgh Med. and Surg. Journ., vol. xi.
July 16th, 1813	Died	3d day	Mortification of limb	Edinburgh Med. and Surg. Journ., vol. xi.
Jan. 17th, 1815	Cured	....	....	Med. Chirurg. Transacts., ix.
Jan. 10th, 1815	Died	8th day	Gangrene of hand and arm	Hodgson on the Arteries.
Sept. 8th, 1817	Cured	....	....	Med. Chirurg. Transacts., vol. ix.
April 12th, 1818	Cured	....	....	Amer. Journ. of Med. Sci., vols. iii. and xiii.
March 7th, 1819	Cured	....	....	Edinburgh Med. and Surg. Journ., vols. xv. & xvi.
April 3d, 1820	Cured	....	....	Edinburgh Med. and Surg. Journ., vol. xvi.
March 19th, 1821	Died	12th day	Inflammation of sac and pleura; had hemorrhage on the 8th, 9th, 10th, and 11th days after operation	Med. Chirurg. Transacts., vol. xii.
Feb. 8th, 1822	Cured	....	....	Dublin Hospital Reports., vol. iii.
1822	Died	7th day	Inflammation of sac, pleura, and pericardium.	Med. Chirurg. Transacts., vol. xiii.
Jan. 5th, 1823	Cured	....	....	Med. Chirurg. Transacts., vol. xii.
Jan. 17th, 1823	Died	3d day	Inflammation of cavity of chest	Med. Chirurg. Rev., vol. vii.
Jan 17th, 1823	Cured	....	....	Gazette Médicale, No. xliv., 1835.
March 7th, 1823	Died	6th day	Gangrene	London Med. and Phys. Journ., vol. ii., New Series, 1827.
April 3d, 1823	Cured	....	....	London Med. Repository, vol. xx.
Sept. 20th, 1823	Cured	....	....	Med. Chirurg. Transacts., vol. xiii.
1823	Died	3d day	Exhaustion	Chir. Clin. of Delpech, tom. i.
August 23d, 1823	Cured	....	....	Edinburgh Med. and Surg. Journ., vol. xxi.
June 6th, 1826	Cured	....	....	London Med. and Phys. Journ., vol. ii., N. S.

No.	Surgeon.	Sex.	Age.	Right or left side.	Disease.	Duration of disease.	Ligature separated.
24	Liston	M.	43	Right side	Aneurism	9 months	....
25	Thorpe	M.	36	Right side	Aneurism	14months	13th day
26	B. Cooper	M.	38	Right side	Aneurism	3 months	....
27	Gibson	M.	35	Left side	Ruptured axillary, from attempts to reduce a luxation	2 days	....
28	Balardini	F	50	Right side	Aneurism	3 months	16th day
29	Dupuytren	M.	40	Right side	Aneurism	....	....
30	Porter	M.	40	Left side	Aneurism	9 days	17th day
31	Baker	F.	18	Right side	Tumor around head of humerus mistaken for aneurism	....	....
32	Crossing	M.	46	Right side	Aneurism	13 weeks	85th day
33	Mott	M.	28	Right side	Aneurism	7 weeks	15th day
34	Bland	M.	63	Right side	Aneurism	....	43d day
35	Buchanan	M.	55	Right side	Secondary hemorrhage after amputation	....	....
36	Mayo	M.	49	Left side	Aneurism	1 month	18th day
37	Fergusson	M.	60	Right side	Aneurism	2 years	31st day
38[1]	Mott	F.	21	Right side	Aneurism	A year or two	....
39	Porter	M.	63	Left side	Aneurism	5 weeks	17th day
40	Brodie	M.	56	Right side	Aneurism	11 weeks	....
41	Lallemand	M.	...	Right side	Wounded axillary	1 day	12th day
42	Auchinloss	M.	65	Left side	Aneurism	18 months	....
43	Nicol	M.	68	Left side	Medullary sarcoma considered aneurismal	13 months	....
44	Nichols	F.	21	Left side	Aneurism	....	21st day
45	Segond	F.	40	....	Aneurism from wound	6 days	11th day
46	Lizars	F.	42	Left side	Aneurism	10 years	....
47[2]	Blasius	M.	...	....	Wounded axillary	20th day	....
48	Haspel	M.	...	....	Wounded axillary	Immediately after	....
49	Hobart	M.	38	Right side	Aneurism	4 months	22d day
50	Earle	M.	...	Left side	Supposed aneurism	....	16th day
51[1]	Hayden	F.	57	Right side	Aneurism	10 months	....
52[2]	Catanoso	M.	33	Right side	Wounded axillary	14 days	....
53	Suetin	M.	44	Left side	Aneurism	....	20th day

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[1] The ligature was here placed internally to the scalenus muscle.

[2] The ligature was here placed below the clavicle.

Date of operation.	Result.	Period of death.	Cause of death.	Work.
Sept. 14th, 1826	Died	14th day	Hemorrhage	Edinburgh Med. and Surg. Journ., vol. xxvii.
June 21st, 1827	Cured	....	....	Amer. Journ. of Med. Sci., vol. ii., 1828.
Dec. 4th, 1827	Died	2 months after	Sloughing of the sac.	Amer. Journ. of Med. Sci., vol. ii., 1828.
March 17th, 1828	Died	8th day	Gangrene of hand and forearm.	Amer. Journ. of Med. Sci., vol. ii., 1828.
Nov. 4th, 1828	Died	About 1 mo. after	Suppuration of tumor	Gazette Médicale, April, 1841.
June 12th, 1829	Died	7th day	....	Lancet, vol. ii., 1833–34.
June 27th, 1829	Cured	....	....	Dublin Hospital Reports, vol. v.
1829	Died	....	....	Lancet, vol. ii., 1828–29.
June 23d, 1830	Cured	....	....	Med. Chirurg. Transacts., vol. xvi.
August 30th, 1830	Cured	....	....	Amer. Journ. of Med. Sci., vol. vii.
Dec. 17th, 1830	Cured	....	....	Amer. Journ. of Med. Sci., vol. ix.
May 1st, 1830	Died	4th day	Gangrene of stump	Glasgow Journal, vol. iii.
March 26th, 1831	Cured	....	....	Med. Chirurg. Transacts., vol xvi.
May 12th, 1831	Cured	....	....	Edinburgh Med. and Surg. Journ., vol. xxxvi.
Sept. 22d, 1831	Died	18th day	Hemorrhage	Amer. Journ. of Med. Sci., vol. xii.
Dec. 31st, 1831	Cured	....	....	Dublin Journal, vol. i.
Dec. 13th, 1831	Died	6th day	Inflammation	London Medical Gazette, vol. ix.
Feb. 19th, 1833	Cured	....	....	Archives Générales, vol. xxxvii.
July 23d, 1833	Died	3d day	Effusion on brain	Edinburgh Med. and Surg. Journ., vol. xlv.
Jan. 16th, 1834	Died	25th day	Hemorrhage	Edinburgh Med. and Surg. Journ., vol. xlii.
April 30th, 1833	Cured	....	....	Amer. Journ. of Med. Sci., vol. xii.
April 5th, 1834	Cured	....	....	Journal Hebdomadaire, tom. i., 1835.
April 27th, 1834	Cured	....	....	Lancet, vol. ii., 1833–34.
1834	Died	2d day	....	Med. Chirurg. Rev., vol. xx.
Feb. 4th, 1835	Died	After some days	Mortification of arm	Gazette des Hôpitaux, 1839, p. 186.
May 7th, 1835	Cured	....	....	Edinburgh Med. and Surg. Journ., vol. xlv.
April 14th, 1835	Supposed cure.	....	....	Amer. Journ. of Med. Sci., vol. xviii.
Sept 15th, 1835	Died	12th day	Hemorrhage	Amer. Journ. of Med. Sci., vol. xxi., 1837.
September, 1835	Cured	....	....	Amer. Journ. of Med. Sci., vol. xx., and Ann. de Chirurgie.
1835	Died	33d day	....	Med. Chir. Rev., vol. xxii.

No.	Surgeon.	Sex.	Age.	Right or left side.	Disease.	Duration of disease.	Ligature separated.
54[1]	O'Reilly	M.	39	....	Aneurism	....	....
55	Montanini	M.	21	Right side	Aneurism from wound	16 days	13th day
56	Rigaud	M.	31	Right side	Aneurism	....	13th day
57	Jobert	M.	61	Right side	Aneurism	6 months	....
58	Syme	M.	23	Left side	Aneurism from ruptured axillary	1 month	....
59	White	M.	...	Left side	Aneurism from wound	2 weeks	17th day
60	Nott	M.	30	....	Aneurism from wound	3 months	31st day
61	Skey	M.	...	Left side	Aneurism	2 months	47th day
62	Hulton	M.	35	....	Aneurism	3 months	12th day
63	Gross	M.	36	Right side	Aneurism	18 months	14th day
64[1]	Partridge	M.	38	Right side	Aneurism	12 months	....
65	B. Cooper	M.	50	Left side	Aneurism	6 weeks	....
66	Hutin	M.	26	....	Wounded axillary	12 days	....
67	McDougall	M.	24	Left side	Aneurism from gunshot	6 weeks	....
68	Mott	M.	35	....	Aneurism from gunshot	22 days	15th day
69	A. C. Post	M.	37	Right side	Hemorrhage after amputation	....	27th day

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[1] The ligature was here placed internally to the scalenus muscle.

Date of operation.	Result.	Period of death.	Cause of death.	Work.
April 16th, 1836	Died	13th day	Hemorrhage	Amer. Journ. of Med. Sci., vol. xxi., 1838.
June 28th, 1836	Cured	....	....	Gazette Médicale, vol. v., 1837.
1836	Died	6 weeks after	Suppuration of tumor	Archives Générales, vol. xlii.
Nov. 22d, 1837	Died	29th day	Hemorrhage	L'Expérience, vol. i., 1838.
Oct. 24th, 1837	Cured after amputation at shoulder-joint, made necessary in consequence of return of hemorrhage.	....	....	Edinburgh Med. and Surg. Journ., vol. 1.
Sept. 17th, 1838	Cured	....	....	Amer. Journ. of Med. Sci., vol. xxiii.
Nov. 27th, 1838	Cured	....	....	Amer. Journ. of Med. Sci., vol. ii. N. S., 1841.
1840	Cured	....	....	Lancet, vol. ii., 1840–41.
Jan. 8th, 1841	Cured	....	....	Lancet, vol. ii., 1840–41.
Feb. 18th, 1841	Died	31st day	Tumor burst into cavity of chest	Western. Journ. Med. and Surg., June, 1841.
Feb. 20th, 1841	Died	4th day	Pericarditis and pleurisy	London Med. Gaz., 1841.
May 18th, 1841	Died	15th day	Pleuro-pneumonia; some hemorrhage day of death	Guy's Hosp. Reports, No. xiii., 1841.
1842	Died	10th day	Hemorrhage	Gazette Médicale, 1842.
Dec. 12th, 1841	Died	7th day	Hemorrhage	Maryland Med. and Surg. Journal, vol. ii., Jan. 1841.
June 11th, 1844	Cured	....	....	New York Journ. of Med., vol. iv.
Dec. 6th, 1844	Cured	....	....	New York Journ. of Med., vol. iv.

Mortality.—Of the sixty-nine cases included in the preceding table, thirty-six recovered and thirty-three died.

Sex.—Of sixty-six cases in which the sex is noted, fifty-nine were males and seven females. Of the seven females, six labored under aneurism, and one presented a tumor around the head of the humerus, which was mistaken for it.

Right or left side.—Of fifty-four cases in which the affected side is mentioned, thirty-one were on the right and twenty-three on the left side.

Age.—This is given in fifty-nine of the cases, of which number there were—

Under 20	1
Between 20 and 30	10
" 30 and 40	22
" 40 and 50	11
" 50 and 60	6
" 60 and 70	8
Above 70	1

Disease or injury.—Of the sixty-nine cases of operations mentioned in the table—fifty-six were done for the cure of aneurism—nine in consequence of wounds or secondary hemorrhages—one was made necessary in consequence of rupture of the axillary in an attempt to reduce an old luxation, and three were done for diseases supposed to be aneurismal.

Period the ligature separated.—In thirty-five of the cases in which it has been noted, the ligature came away—in one, on the eleventh day; in six, on the twelfth; in four, on the thirteenth; in one, on the fourteenth; in three, on the fifteenth; in four, on the sixteenth; in three, on the seventeenth; in two, on the eighteenth; in one, on the nineteenth; in one, on the twentieth; in one, on the twenty-first; in two, on the twenty-second; in one, on the twenty-seventh; in two, on the thirty-first; in one, on the forty-third; in one, on the forty-seventh; and in one, on the eighty-fifth.

Return of pulsation in the tumor after the application of the ligature.—In three of the sixty-nine cases, pulsation returned in the aneurismal tumor after the operation. In one of these (No. 12) it was discovered thirty hours after the operation, and the patient died after repeated hemorrhages. In the second case (No. 11) it was noticed the day after the operation, and disappeared in two days, the patient recovering, and in the third instance (No. 60) it was observed two days after the operation, and at the end of forty days was still strong, though ultimately the disease was cured.

Hemorrhage after the operation.—With three exceptions, all the cases in which secondary hemorrhage followed the operation proved fatal. In two of these (Nos. 19 and 52) it occurred before the separation of the ligature, on the sixteenth and nineteenth days, and, in the third case (No. 37), it came on on the fourth and fifth days after the ligature had been cut off.

Bursting of the tumor.—In six cases the tumor is stated to have suppurated, and either to have been opened or to have burst externally after the operation. Of these, four were cured (Nos. 8, 30, 37, and 62) and two died. In two of them the suppuration did not occur till about the seventh week after the operation, and both of these did well.

In two of the cases in the table, the *contents of the tumor were discharged through the lungs*, this termination in one case being followed by restoration to health, and in the other by death. The operation in the first of these (No. 19) was done on the third of April, and on the 21st, the tumor began to increase, and was evidently suppurating. On the 29th, six or eight ounces of bloody pus were brought up during a paroxysm of coughing, and the tumor suddenly diminished to one-half its size. It was now punctured, and five ounces of the same kind of matter was discharged, to the great relief of the patient. A cavity could now be distinctly felt between the 1st and 2d ribs at their sternal ends, through which the fluid had passed into the lungs, and there being a free communication, the air passed into the sac whenever he coughed, which distended it, and sometimes escaped by the external opening. The discharge from the outer opening gradually lessened, and, at the end of three weeks, ceased. His cough slowly wore off, and ninety-two days after the operation the patient was quite well.

In the second of these interesting cases (No. 63), the operation was done by our countryman, Dr. Gross, on the 18th of February. After its performance, the contents of the tumor became solidified, and its volume progressively diminished. On the 15th of March, the patient suffered from fever, and a slight degree of tenderness on the apex of the tumor was observed. On the 16th, he was suddenly seized with intense pain in the chest, which was particularly severe at the base of the right lung, and extended up towards the axilla. The respiration throughout the right lung was bronchial, and there was dulness on percussion over the lower ribs; the aneurismal tumor had suddenly disappeared at the time of the attack. On the 18th, the patient experienced a sensation as if a fluid was passing from the pleuritic cavity into that of the aneurismal tumor, and, upon auscultation, a plashing sound was heard at every inspiration, the noise resembling that produced by shaking water in a closed vessel. On the 20th, he died. Upon dissection, the aneurismal tumor was found to communicate by an aperture, one inch and three-quarters in length by an inch and a half in width, with the pleuritic cavity; it was situated between the first and second ribs, and was obviously the result of ulcerative absorption, induced by pressure of the tumor. Both ribs were denuded of their periosteum. The right side of the chest contained nearly three quarts of bloody serum, intermixed with laminated clots and flakes of lymph, the former of which had evidently been lodged originally in the aneurismal sac.

The discharge of the contents of a subclavian or axillary aneurism into the lung is a rare termination of it, and, in connection with the two cases given, it may be well to notice one somewhat similar, which has been recorded by M. Neret, of Nancy. The patient, aged 38, was admitted into the hospital St. Charles for hæmoptysis, and was found to labor under an aneurism of the left subclavian, of the size of a large chestnut, which had existed about eight months. He died a short time after his admission, and on dissection, the aneurism was found communicating with a cavity in the upper part of the lung, of the size of the head of a new-born infant. A case of a similar kind is related in his work on the arteries by Mr. Guthrie.

Cause of death.—Of the sixty-nine cases, thirty-three, or nearly one-half, died. Of these, two died from sloughing of the tumor; nine, from hemorrhage coming on at various periods between the fourth and thirty-third days; five, from inflammation within the chest; six, from mortification of the extremity; one, from effusion on the brain; one, from exhaustion; one, from inflammation; three, from suppuration of the tumor; and in five cases the cause of death is not given.

Mistakes in diagnosis.—In two of the cases contained in the table, the aneurisms had been mistaken for abscesses, and punctured previous to the operation. In three other cases, malignant tumors about the shoulder were looked upon as aneurisms. The first of these cases (No. 31) was that of a female, aged eighteen, operated upon in the New Castle Infirmary, England. It proved to be a fungus hæmatodes. It became less in size after ligature of the vessel, but speedily assumed a serious aspect, and soon terminated her existence. The artery was found obliterated for at least one inch. In No. 43, the true nature of the affection was a medullary sarcoma of the upper part of the humerus. In the third of these cases (No. 50), the artery was taken up in April, 1835, and the aneurism supposed to be cured. On the 2d of July of the same year, the patient died of dropsy, and on dissection it became evident that no aneurism had ever existed. The tumor was of a dense structure and lying over the artery.

Difficulties of the operation.—These need not here be dwelt upon—every practical surgeon must be aware that at times they must be very great. Our only object at present is to call attention to the fact, that some of the most celebrated operators have failed in their efforts to pass a ligature around the subclavian. In a case at Guy's Hospital, Sir Astley Cooper attempted to tie the vessel above the clavicle. The aneurism was very large, and the clavicle thrust upwards by the tumor so as to make it impossible to pass a ligature under the artery without incurring the risk of including some of the nerves of the axillary plexus. The attempt was, therefore, abandoned. In a case of large aneurism of the right side, of four years' standing, which occurred to M. Dupuytren, in 1819, he succeeded, as he believed, after one hour and forty-eight minutes, in placing a ligature around the subclavian from above the clavicle. Pulsation in the tumor continued after the operation, which M. Dupuyten stated to have been the most tedious, difficult, and painful that he had ever attempted, and after death, which occurred on the ninth day, the ligature was found knotted loosely on that portion of the fourth cervical, which afterwards becomes the external cutaneous or musculo-cutaneous nerve, and the artery was not included in the ligature.

In the case of a soldier, aged 27, with hemorrhage from the armpit, resulting from a wound received in a duel, Prof. Lallemand attempted, without success, to place a ligature upon the subclavian from above the clavicle. The hemorrhage was arrested by ligature of the wounded vessel, and he lived till the following day. In a case of aneurism which occurred to Mr. Cusack, of Dublin, he attempted to place a ligature on the subclavian in its third stage, and in endeavoring to pass it, the aneurism was penetrated. An alarming gush of blood followed, which was arrested by plugging up the wound; the man survived ten days, dying of hemorrhage.

In one case included in our table (No. 16), the sac was accidentally punctured by the needle in the attempt to pass it beneath the vessel, and gave rise to "terrific hemorrhage." Even after the ligature was secured, the bleeding was not checked till a sponge tent in the wound, and pressure, were applied.

In No. 11 (which, by the way, was the first successful operation for axillary aneurism in Great Britain), the inferior nervous band, passing out to form the axillary plexus, was surrounded by the ligature instead of the artery; the mistake, however, was soon discovered; and the ligature, still retained, was used to pull the nerve a little upwards from its situation, so as to admit of the more ready exposure and deligation of the artery.

In cases of great difficulty of passing the ligature around the artery, it has been proposed by Mr. Hargrave and M. Cruveilhier to saw through or excise a portion of the clavicle —a procedure we should suppose which would greatly tend to increase the danger of the operation.

II. Mortality Following the Operation of

No.	Surgeon	Sex.	Age.	Right or left side.	Disease.	Duration of disease.	Ligature separated.
1	Abernethy	M.	34	Right side	Secondary hemorrhage after ligature of femoral	....	....
2	Abernethy	M.	40	Left side	Aneurism	11 weeks	about the 20th day
3	Abernethy	F.	40	....	Aneurism	....	about the 12th day
4	Freer	M.	27	....	Aneurism	4 months	16th day
5	Abernethy	M.	40	....	Aneurism	....	10th day
6	Tomlinson	M.	40	....	Aneurism	4 months	26th day
7	Goodlad	M.	41	....	Aneurism	3 years	16th day
8	Dorsey	M.	30	Right side	Aneurism	2 years	14th day
9	A. Cooper	M.	39	Right side	Aneurism	3 months	17th day
10	Delaporte	M.	60	Left side	Aneurism	....	....
11	A. Cooper	M.	37	....	Aneurism	....	....
12	A. Cooper	M.	...	....	Aneurism	....	....
13	Ramsden	M.	75	....	Aneurism	of long duration	....
14	Albert	...	...	....	Aneurism	....	....
15	Bouchet	M.	55	....	Aneurism	4 years	17th day
16	A. Cooper	M.	27	Left side	Aneurism	....	17th day
17	Brodie	...	...	....	Aneurism	....	....
18	Norman	M.	50	....	Aneurism	2 weeks	19th day
19	Mackesy	M.	50	....	Aneurism	1 year	11th day
20	Post	M.	41	Left side	Aneurism	3½ months	13th day
21	Lawrence	M.	40	Left side	Aneurism	2 weeks	24th day
22	Whitbridge	M.	19	....	Aneurism	....	16th day
23	Newbigging	M.	30	Right side	Aneurism in both groin and ham	8 months	17th day
24	Delpech	M.	27	Left side	Aneurism	....	....
25	Moulaud	M.	30	Right side	Aneurism	....	24th day
26	....	M.	30	....	Aneurism	....	....
27	H. Cline	...	...	....	Aneurism	....	17th day
28	Soden	M.	56	Right side	Aneurism	4 months	16th day
29	Collier	M.	24	Right side	Aneurism from gunshot	2 months	....
30	Dupuytren	M.	45	Left side	Aneurism	14 months	16th day

Tying the Iliac Arteries.

Date of operation.	Result.	Period of death.	Cause of death.	Work.
March, 1796	Died	8th day	Hemorrhage	Surgical Works, vol. ii., 1825.
October 24	Died	23d day	Sloughing of the sac	Surgical Works, vol. ii.
Oct. 11, 1806	Cured	....	....	Surgical Works, vol. ii.
Oct. 4, 1806	Cured	....	....	On Aneurism.
Feb. 25, 1809	Cured	....	....	Surgical Works, vol. ii.
Aug. 29, 1807	Cured	....	....	Lond. Med. and Phys. Journ., vol. xviii.
July 29, 1811	Cured	....	....	Edinburgh Med. and Surg. Journ., vol. viii., 1812.
Aug. 19, 1811	Cured	....	....	Eclectic Repertory, vol. ii., 1812.
June 22, 1808	Cured	....	....	Guy's Hospital Reports, vol. i., 1836.
Jan. 3, 1810	Died	14th day	Mortification of limb	Mems. de la Soc. Méd., d'Emulation, tom. vii.
Aug. 24, 1810	Cured	....	....	Med. Chirurg. Transacts., vol. iv.
Feb. 14, 1811	Died	10 weeks & 6 days after	Bursting of an aneurism of the aorta	Med. Chirurg. Transacts., vol. iv.
....	Died	3d day	"Extreme debility"	Hodgson on the Arteries, p. 418.
....	Died	less than 3 weeks	Mortification of limb, and patient died with symptoms of tetanus	Hodgson on the Arteries.
1812	Cured	....	....	Breschet's Trans. of Hodgson, tom. ii.
April, 30, 1813	Cured	....	....	Med. Chirurg. Transacts., vol. iv.
....	Cured	....	....	Hodgson on the Arteries.
Sept. 13, 1813	Cured	....	....	Med. Chirurg. Transacts., vol. x., 1819.
Oct. 18, 1813	Cured	....	....	Edinburgh Med. and Surg. Journ., vol. xi., 1815.
Jan. 4, 1814	Cured	....	....	American Med. and Phys. Register, vol. iv.
Jan. 11, 1814	Cured	....	....	Med. Chirurg. Transacts., vol. vi., 1815.
Jan. 8, 1815	Died	28th day	Mortification of limb	New England Journ., vol. iv.
March 13, 1815	Cured	....	....	Edinburgh Med. and Surg. Journ. vol. xii., 1816.
July 2, 1815	Died	10th day	Mortification of limb	Clinique Chirurgicale, tom. i. p. 38.
1815	Cured	....	....	Casamayor on Aneurism.
....	Died	in 3d week	Mortification of limb	Hodgson on the Arteries, p. 198.
....	Cured	....	....	Med. Chirurg. Transacts., vol. vi., 1815.
April 22, 1816	Cured	....	....	Med. Chirurg. Transacts., vol. vii., 1816.
Aug. 28, 1816	Died	3d day	Mortification of limb	Med. Chirurg. Transacts., vol. vii., 1816.
Oct. 15, 1816	Cured	....	....	Breschet's Trans. of Hodgson, tom. ii.

No.	Surgeon.	Sex.	Age.	Right or left side.	Disease.	Duration of disease.	Ligature separated.
31	Hicks	M.	...	....	Hemorrhage from a sloughing bubo	....	....
32	Norman	M.	50	Right side	Aneurism	2 weeks	....
33	Robertson	M.	38	Right side	Aneurism	5 weeks	12th day
34	Norman	M.	14	Left side	Secondary hemorrhage from wound	....	21st day
35	Cole	M.	29	....	Aneurism	....	19th day
36	Bond	M.	31	Right side	Aneurism	3 years	15th day
37	Wilmot	M.	32	....	Aneurism	....	31st day
38	Liston	M.	35	Left side	Aneurism	5 weeks	16th day
39	Kirby	M.	34	Left side	Aneurism	3 months	18th day
40	Todd	F.	22	....	Aneurism	5 months	....
41	N. Smith	M.	...	Left side	Aneurism	1 month	20th day
42	Todd	M.	28	Left side	Aneurism	7 months	21st day
43	Salmon	M.	29	....	Aneurism	10 months	21st day
44	Jameson	M.	...	Right side	Aneurism	6 months	....
45	Key	M.	26	Right side	Aneurism	1 year	12th day
46	Stevens	M.	...	....	Secondary hemorrhage from punctured wound	....	22d day
47	Warren	...	...	Right side	Aneurism	....	18th day
48	B. Cooper	M.	49	Left side	Aneurism	2 weeks	....
49	Arendt	M.	44	....	Aneurism	....	....
50	Wright	M.	42	Left side	Inguinal and popliteal aneurisms	1 year	....
51	Tait	M.	54	Right side	Aneurism	4 months	21st day
52	Tait	M.	54	Left side	Aneurism	14 months	42d day
53	Rogers	M.	...	Left side	Aneurism	4 weeks	....
54	....	M.	...	....	Wounded artery	....	....
55	Gibbs	M.	39	....	Hemorrhage from ulceration	....	13th day
56	Brodie	M.	38	Left side	Aneurism	3 months	....

Date of operation.	Result.	Period of death.	Cause of death.	Work.
Jan. 22, 1817	Cured after amputation, made necessary in consequence of gangrene of limb	....	....	Hennen's Military Surg. 1829, p. 187.
April 6, 1817	Died	12th day	Peritonitis and sloughing of wound	Med. Chirurg. Transacts., vol. x.
July 24, 1817	Cured	....	....	Edinburgh Med. and Surg. Journ., vol. xiii., 1817.
Aug 27, 1817	Cured after amputation, made necessary in consequence of gangrene of limb	....	....	Med Chirurg. Transacts., vol. x.
1817	Cured	....	....	Casamayor on Aneurism.
June 6, 1818	Cured	....	....	Lond. Med. and Physical Journ., vol. iv.
July 9, 1818	Cured	....	....	Dublin Hospital Reports, vol. ii., 1828.
Nov. 6, 1819	Cured	....	....	Edinburgh Med. and Surg. Journ., vol. xvi., 1820.
Dec. 18, 1811	Cured	....	....	Surgical Cases, p. 101.
June 3, 1819	Died	15th day	Gangrene of the sac	Dublin Hospital Reports, vol. iii., 1822.
July 25, 1820	Cured	....	....	Phila. Journ. Med. and Phys. Sci., vol. i., 1820.
Dec. 4, 1820	Died	21st day	Tetanus	Dublin Hospital Reports, vol. iii., 1822.
Sept. 12, 1820	Cured	....	....	Med. Chirurg. Transacts., vol. xii., 1822.
May 6, 1821	Died	9th day	Mortification of limb	Philada. Med. Recorder, vol. v., 1822.
Sept. 28, 1822	Cured	....	....	Guy's Hospital Reports, vol. i., 1836.
March 12, 1822	Cured	....	....	N. Y. Med. and Physical Journ., vol. i., 1822.
Feb. 18, 1823	Cured	....	....	New England Journ., vol. xii., 1823.
June 21, 1823	Died	27th day	Hemorrhage	Tyrrell's Cooper, vol. ii.
1824	Cured	....	....	Philada. Med. Recorder, vol. vii., 1824.
Sept. 22, 1824	Cured	....	....	London Med. and Phys. Journ., vol. iv., 1828.
May 8, 1825	Cured	....	....	Edinburgh Med. and Surg. Journ., vol. xxvi., 1824.
April 16, 1826	Cured	....	....	Edinburgh Med. and Surg. Journ., vol. xxvi., 1824.
1826	Cured	....	....	Philada. Med. Recorder, vol. ix., 1826.
Nov. 1826	Cured	....	....	Gazette Médicale, 1833. p. 650.
Feb. 26, 1827	Cured	....	....	London Med. and Phys. Journ., vol. v., 1827.
Feb. 21, 1828	Cured	....	....	Amer. Journ. Med. Sci., vol. ix., 1831.

No.	Surgeon.	Sex.	Age.	Right or left side.	Disease.	Duration of disease.	Ligature separated.
57	Randolph	M.	46	Right side	Aneurism	2 years	22d day
58	Daniel	M.	63	Right side	Aneurism	8 months	....
59	Ewing	M.	37	Right side	Aneurism	7 weeks	62d day
60	Morrison	M.	...	Right side	Aneurism	....	15th day
61	Mott	M.	13	Right side	Diffuse femoral aneurism	....	34th day
62	B. Cooper	M.	44	Left side	Aneurism	3 months	22d day
63	Velpeau	M.	16	....	Wounded artery	....	17th day
64	Hall	M.	35	Left side	Aneurism	3 months	22d day
65	Guthrie	M.	28	....	Aneurism	....	28th day
66	Sinclair	M.	28	Right side	Aneurism	6 months	30th day
67	Guthrie	M.	27	Left side	Aneurism	3 months	....
68	Smith	M.	40	..........,	Aneurism	19 months	30th day
69	Laidlaw	M.	40	Right side	Hemorrhage from a sloughing carbuncle	....	10th day
70	Ruan	M.	48	Right side	Aneurism	5 weeks	24th day
71	Mc Farlane	F.	30	Right side	Secondary hemorrhage from wound	....	....
72	Mirault	M.	36	Left side	Aneurism	....	....
73	Morrison	M.	35	Left side	Varicose inguinal aneurism	11 years	....
74	Warren	M.	56	Left side	Aneurism	4 months	....
75	Morrison	M,	25	Left side	Aneurism	....	14th day
76	Hobart	M.	42	Left side	Aneurism	12 months	29th day
77	Hewson	M.	23	Right side	Hemorrhage following amputation	....	29th day
78	Liston	M	45	Left side	Hemorrhage following amputation of thigh	....	17th day
79	Lallemand	M.	27	....	Varicose femoral aneurism	5 years	....
80	Horner	M.	48	Right side	Aneurism	11 weeks	....
81	Medoro	M.	33	Right side	Aneurism	....	19th day
82	Porter	...	...	....	Aneurism	....	....
83	Bulchrens	M.	39	....	Hemorrhage from a wound	....	....
84	Portal	M.	30	Right side	Hemorrhage from a sloughing bubo	....	....
85	Dickson	F.	43	Left side	Aneurism	2 months	35th day
86	Mouret	M.	...	....	Secondary hemorrhage	....	17th day
87	Petrunti	M.	26	....	Aneurism	....	17th day

Date of operation.	Result.	Period of death.	Cause of death.	Work.
Oct. 28, 1828	Cured	....	....	N. Amer. Med. and Surg. Journ., vol. vii., 1829.
Nov. 7, 1829	Died	11th day	Affection of the chest, probably diseased heart	Med. Chirurg. Review, vol. xi., 1829.
Jan. 3, 1831	Cured	....	....	Edinburgh Med. and Surg. Journ., vol. xxxvi., 1831.
Nov. 30, 1830	Cured	....	....	Amer. Journ Med. Sci., vol. xix., 1836.
April 25, 1831	Cured	....	....	Amer. Journ. Med. Sci., vol. viii., 1831.
July 19, 1831	Cured	....	....	London Med. and Phys. Journ., vol. xii., 1832.
Oct. 6, 1831	Cured	....	....	Journal Hebdomadaire, vol. vi., 1832.
Oct. 7, 1831	Cured	....	....	Amer. Journ. Med. Sci., vol. x., 1832.
Nov. 19, 1831	Cured	....	....	London Med. and Phys. Journ., vol. xii. 1832
April 3, 1832	Cured	....	....	Lancet, vol. ii., 1832–3.
Sept. 11, 1832	Died	3d day	Mortification of limb	London Med. and Phys. Journ., vol xi., 1831.
May 21, 1833	Cured	....	....	Lancet, vol. ii., 1832–3.
May 17, 1835	Cured	....	....	Lancet, vol. i., 1838–9.
June 21, 1835	Cured	....	....	Amer. Journ. Med. Sci., vol. xviii., 1836.
Jan. 7, 1836	Died	in 3 hours	....	Hosp. Report of Glasgow, from 1835 to Aug. 1836.
June 15, 1836	Cured	....	....	Mems. de l'Acad. Roy. de Méd., tom. vii., 1838.
Nov. 5, 1836	Died	3d day	Mortification of limb	Amer Journ. Med. Sci., vol. xxii., 1838.
Dec. 5, 1836	Died	2d day	Delirium tremens	Boston Med. and Surgical Journ., vol. xv., 1836.
March 12, 1837	Cured	....	....	Amer. Journ. Med. Sci., vol. xxii . 1838.
June 23, 1837	Cured	....	....	Edinburgh Med. and Surg. Journ., vol. i., 1838.
Aug. 22, 1837	Cured	....	....	Med. Chirurg. Transacts., vol. xxi., 1838.
March 16, 1838	Cured	....	....	Lancet, vol. ii., 1838–9.
May 24, 1838	Died	5th day	Hemorrhage	Gazette Médicale, No. xi , 1841.
July 17, 1838	Died	5th day	Prostration	Amer. Journ. Med. Sci., vol. iv., 1842.
Aug. 27, 1838	Cured	....	....	Gazette Médicale, 1839, p. 586.
October, 1838	Died	4th day	Diffuse inflammation	On Aneurism, p. 121.
1838	Died	6th day	Mortification of limb	Gazette Médicale, 1839, p. 234.
1838	Died	4th day	Mortification of limb	Boston Medical and Surg. Journ., No. xxvi., 1839.
June 30, 1839	Cured	....	....	N. Y. Journ of Med. and Surg., vol. i., 1839.
1839	Cured	....	....	Journ. de Conn. Med. Chir., June, 1839.
Oct. 18, 1839	Cured	....	....	Gazette Médicale, May, 1839, No xix.

No.	Surgeon.	Sex.	Age.	Right or left side.	Disease.	Duration of disease.	Ligature separated.
88	Monod	M.	57	Right side	Aneurism	4 months	....
89	Thomson	M.	46	Left side	Hemorrhage following amputation	....	18th day
90	Baroni	M.	36	....	Varicose inguinal aneurism	....	19th day
91	Houston	M.	26	Left side	Aneurism	1 year	22d day
92	Peace	M.	28	Right side	Aneurism	4 months	30th day
93	Venturoli	M.	50	Left side	Aneurism	....	....
94	Power	M.	61	Right side	Aneurism	15 months	....
95	Bellingham	F.	32	Right side	Aueurism	3 months	24th day
96	Paul	M.	20	....	Hemorrhage following amputation	....	34th day
97	Boling	F.	20	Left side	Aneurism	3 weeks	23d day
98	Brainard	M.	...	Right side	Aneurism	12 weeks	23d day
99	Lisfranc	M	...	....	Aneurism	....	....
100	Taylor	M.	24	Right side	Aneurism	6 months	16th day
101	B. Cooper	M.	42	Right side	Aneurism	6 months	22d day
102	Duncan	M.	30	....	Aneurism	9 months	22d day
103	Shepherd	M.	48	Right side	Secondary hemorrhage after ligature of femoral	....	27th day
104	James	M.	...	Left side	Femoral and popliteal aneurisms	....	15th day
105	Busk	M.	30	Right side	Aneurism	8 months	19th day
106	Liston	M.	...	Right side	Aneurism foll. wound of a superficial branch of femoral	11 days	....
107	Harrison	M.	32	Right side	Aneurism	3 or 4 years	....
108	Kidd	F.	22	Right side	Aneurism	5 years	19th day
109	Gay	M.	48	Right side	Aneurism	3 years	18th day
110	Brodie	M.	31	....	Aneurism	3 weeks	25th day
111	J. Cooper	M.	57	Right side	Aneurism	6 months	42d day
112	Fowler	M.	30	Left side	Inguinal and popliteal aneurisms	3 years	....
113	Malgaigne	M.	31	Left side	Aneurism	15 months	16th day
114	A. Cooper	M.	38	....	Aneurism	....	....
115	Rousset	M.	21	Right side	Secondary hemorrhage	....	....
116	Crosse	M.	31	Right side	Aneurism	upwards of 3 years	15th day
117	Crosse	M.	40	Left side	Aneurism	18 months	16th day
118	Crosse	M.	...	Right side	Aneurism	3 or 4 "	13th day

Date of operation.	Result.	Period of death.	Cause of death.	Work.
March 10, 1840	Died	7th day	Sloughing of sac	Archives Génerales, 1840.
Feb. 11, 1840	Cured	....	....	Med. Chirurgical Review, July, 1841.
1840	Died	54th day	Hemorrhage	Archives Génerales, 1840.
June 23, 1840	Cured	....	....	Dublin Journal of Med., vol. xxii., 1842.
July 24, 1841	Cured	....	....	Philada. Med. Examiner, vol. v., 1842.
1841	Died	....	Mortification of limb	Annales de Chirurgie, tom. iii., 1842.
July 19, 1842	Died	5th day	Hemorrhage	Maryland Med. and Surg. Journ., vol. iii., 1841.
Aug. 26, 1842	Cured	....	....	Medical Examiner, Oct. 1842.
Aug. 31, 1842	Cured	....	....	Lond. and Edin. Monthly Journ., Feb. 1843.
Aug. 1, 1843	Cured	....	....	Amer. Journ. Med. Sci., vol. vii., 1844.
Feb. 24, 1843	Cured	....	....	Amer. Journ. Med. Sci., vol. vi., 1843.
May, 1836	Cured	....	....	Archives Générales, tom. xli., 1836.
1835	Cured	....	....	Amer. Journ. Med. Sci., vol. xvii., 1836.
Feb. 20, 1844	Cured after amputation, made necessary in consequence of gangrene of limb	....	....	Lancet, vol. i., 1844.
1845	Cured	....	....	Northern Journal of Med., March, 1845.
Sept. 1, 1825	Cured	....	....	Midland Med. and Surg. Reporter, vol. i., 1828-9.
Aug. 16, 1843	Cured	....	....	Provincial Med. and Surg. Trans., vol. xii.
Jan. 19, 1845	Cured	....	....	Lancet, vol. i., 1845.
May, 31, 1845	Died	35 hours after	Peritonitis	Lancet, 1845.
June 17, 1845	Died	8th day	Tetanus	London Med. and Surgical Journ., Oct. 1845.
Oct. 28, 1845	Cured	....	....	Dublin Med. Press, Jan. 1846.
Dec. 3, 1845	Cured	....	....	Lancet, vol. i., 1846.
May 30, 1839	Cured	....	....	London Med. Gazette, vol. i., 1846.
Feb. 3, 1846	Cured	....	....	Lancet, vol. i., 1846.
Sept. 2, 1839	Died	30th day	Mortification of limb	Lancet, vol. ii., 1846.
Feb. 11, 1844	Cured	....	. ...	Journ. de Chirurgie, 1846.
Aug. 19, 1816	Died	17th day	Hemorrhage	Roux's, Parallel, p. 236.
Oct. 9, 1843	Cured	....	....	Journ. de Chirurgie, 1846.
June 7, 1818	Cured	....	....	Provincial Med. and Surg. Journ., Aug. 1846.
Sept. 1825	Cured	....	....	Provincial Med. and Surg. Journ., Aug. 1846.
Sept. 7, 1842	Cured	....	....	Provincial Med. and Surg. Jurn., Aug. 1856.

Mortality.—Of the one hundred and eighteen cases included in the table, eighty-five recovered, and thirty-three died—three of the patients who recovered undergoing amputation in consequence of gangrene of the limbs.

Sex.—Of one hundred and thirteen cases in which the sex is noted, one hundred and seven were males, and six females. Of the six females, five labored under aneurisms, and one had secondary hemorrhage.

Right or left side.—Of seventy-nine cases in which the affected side is noticed, forty-four were on the right, and thirty-five on the left side.

Age.—The age is given in ninety-nine of the cases, of which number there were—

Under 20	4
Between 20 and 30	23
" 30 " 40	32
" 40 " 50	25
" 50 " 60	11
" 60 " 70	3
Above 70	1
	99

Disease or injury.—Of the one hundred and eighteen cases of operations given in the table, ninety-seven were done for the cure of aneurisms, eighteen in consequence of wounds or secondary hemorrhages, and three for the cure of varicose aneurisms. In four of the ninety-seven cases of aneurism, that disease existed simultaneously in both the ham and the front of the thigh, and in three of these the operation succeeded in curing both tumors.

Period the ligature separated.—This is noted in seventy-eight cases, in forty-four of which the ligature came away before the twentieth day; in twenty-four, between the twentieth and thirtieth days; in seven, between the thirtieth and fortieth days; and in three beyond the fortieth day. The earliest period at which the ligature came away was the tenth day, and the longest time to which it remained was the sixty-second day.

Return of pulsation in the tumor after the application of the ligature.—This occurred in nine cases. In one of these (No.

18), evident pulsation was noticed in the sac on the fifth day, which gradually ceased at the end of ten or twelve days, the patient recovering. In the second case (No. 20), pulsation returned in the tumor more than two months after the operation, and after a time ceased. In the third (No. 23), aneurisms existed both in the popliteal and inguinal regions. Pulsation in the ham entirely ceased upon the application of the ligature, but continued, though feebly, in the inguinal tumor; both aneurisms were ultimately cured. In the fourth (No. 30), pulsation reappeared, and remained till the forty-fourth day, the patient recovering. In the fifth (No. 49), slight pulsation was observed a few hours after the operation, and on the following day was so considerable, that compression was made on the artery, and kept up so as to arrest it; the cure being complete. In the sixth (No. 90), which was a varicose inguinal aneurism, circulation through the tumor was observed to have returned on the third day, and the patient died after repeated hemorrhages, on the fifty-fourth day. In the seventh (No. 94), slight pulsation was noticed on the day following the operation, and the patient died on the fifth day of hemorrhage. In the eighth (No. 104), both femoral and popliteal aneurisms existed. On the day after the operation, both tumors were solid; no pulsation was perceived in the ham, but a slight tremulous motion was noticed in the groin. From this period, pulsation increased in the groin, and after a few days returned in the ham also, where, however, it soon entirely ceased. At the date of the report of the case (about six months after the ligature of the vessel), it continued in the groin, though very feebly. In the ninth (No. 110), the operation was done in the month of May, and the patient discharged cured in August, but was readmitted in the following November, with a return of pulsation in the tumor. Pressure was employed for two months, after which he was again looked upon as cured. In November, 1841, a recurrence of pulsation was again noticed. In January, 1842, all pulsation had ceased, but the tumor had increased. In January, 1843, it became stationary, and some time after began to diminish in size, and so continued to do till July of the same year, when he died of phthisis. On post-mortem examination, the tumor was found to be connected with the superficial femoral artery immediately below its origin, was of the size of a full-grown fœtal head, and perfectly solid.

Hemorrhage after the operation.—This is stated to have occurred in fourteen cases; of these, seven died, and seven were cured. In Nos. 1, 79, 94, and 114, it took place on the fifth day, and in them all proved fatal. In the fourth and fifth cases (Nos. 25 and 99), hemorrhage once occurred in each, but the patients did well. In the sixth (No. 30), a considerable quantity of arterial blood escaped from the wound from the twenty-fourth to the thirtieth day, which was believed to come from the inferior end of the artery, and was successfully arrested by compression. In the seventh (No. 34), which was a case of hemorrhage from the upper and outer part of the thigh, the bleeding continued after the external iliac had been secured, and a ligature was placed on the femoral, which restrained it. The limb afterwards mortified, and was amputated, the patient doing well. In the eighth case (No. 42), the hemorrhage occurred at several intervals between the twenty-fourth and forty-third days after the operation, when a second ligature was placed on the vessel higher up than the first, but without success. In the ninth (No. 48), repeated hemorrhages occurred after the nineteenth day, and the patient died. In the tenth (No. 77), the artery was ligatured on the 22d of August, for hemorrhage following amputation; on the 28th, bleeding took place from the groin, which was restrained by pressure with a truss, and the patient cured. In the eleventh (No. 78), the vessel was also tied for hemorrhage after amputation; ligature of the femoral having been first tried ineffectually. On the day following the operation, there was a slight return, which was arrested by pressure. In the twelfth case (No. 90), which was one of varicose aneurism, it took place on the fortieth day after the application of the ligature from the inferior end of the wound. On the forty-third day there was another frightful return of it, when the aneurismal tumor was laid open with a view of tying all the bleeding vessels; the loss of blood when this was done, was such as to make the operator fear the man would die on the table; he, however, lived eleven days. In the thirteenth (No. 96), the artery was tied to arrest hemorrhage from a stump, and more than six weeks after it, in consequence of a return of bleeding, it was again secured higher up than at first, and the patient cured. In the fourteenth (No. 114), it occurred on the seventeenth day, and proved fatal.

Suppuration of the sac.—In ten cases, the tumor is stated to have suppurated after the operation, all of which did well. In one of these (No. 16), the integuments were in a state of mortification at the time of the operation, and on the twenty-third day after it, an incision was made into the tumor, and its contents evacuated. In another (No. 75), the tumor, which is stated to have been "of enormous size," suppurated and was punctured on the 25th of March. On the 31st and 2d of April, hemorrhages occurred from it, and a fruitless effort was made to take up the profunda. On the 12th, the bleeding was renewed, and the actual cautery was applied. On the 14th, "apprehensive of another hemorrhage," an effort was made to tie the internal circumflex without success, and the actual cautery was again resorted to. In a third (No. 95), where the ligature had been applied close to the bifurcation of the common iliac, the tumor discharged itself through the wound on the twenty-first day, and in No. 113 the same occurrence had taken place on the twenty-ninth day.

Gangrene of the limb.—This occurred in sixteen out of the one hundred and eighteen cases; three of which were cured after amputation, and twelve died. In one case (No. 31), the artery was tied on the 22d of January, mortification followed, which extended to the thigh, and on the 9th of February amputation was done close to the trochanter. In a second (No. 34), the ligature was applied August 27th, and the limb was amputated September 26th. In both of these cases the vessel was secured to restrain hemorrhage. In the third case (No. 101), the operation was done for femoral aneurism on the 20th of February. The ligature separated on the twenty-second day, and about a week after this occurred, gangrene was observed in the toe, and gradually extended up to within a short distance of the knee, where the limb was removed. These amputations were all successful. In one instance (No. 61), slight sloughing of the sole of the foot occurred from a bottle of hot water applied to the part.

Cause of death.—Of the one hundred and eighteen cases, thirty-three died. Of these, six died from hemorrhage; three, from sloughing of the sac; thirteen, from mortification of the limb; one, from the bursting of an aneurism of the aorta at its bifurcation, ten weeks and six days after the operation; two, on the third and fifth days from prostration; two, of peritonitis; two, of tetanus; one, on the eleventh day of some affection of the chest—probably diseased heart; one, on the second day, of delirium tremens; one, of diffuse inflammation, and in one, the cause is not noted.

Difficulties of, and accidents during the operation.—In two instances (Nos. 20 and 51), the peritoneum was wounded in the operation. Both patients recovered. In one (No. 74), the sac was accidentally wounded after the ligature was applied. In one (No. 91), a vein—the circumflex ilii—was a source of much embarrassment to the operator, who gives with his case a plate representing it.

Mistakes in diagnosis.—In four of the cases given in the table (Nos. 22, 40, 67, and 88), the tumors had been mistaken for abscesses and opened previous to the operation. Of these none recovered. In No. 106, the aneurism which followed a gunshot wound was supposed to arise from a wound of the femoral. Upon examination it was found that the ball did not pierce the fascia lata, but had passed altogether in the subcutaneous fat, and that the only vessel wounded was a superficial branch of the femoral artery, which was divided close under Poupart's ligament and nearly an inch from the main trunk.

Mr. Fergusson[1] mentions that he has seen "a most experienced and judicious surgeon cut through the parietes of the abdomen with the intention of tying the external iliac artery for a supposed aneurism where none existed." This case is, I presume, that which has been recorded by Mr. Syme in one of his Surgical Reports in the *Edinburgh Journal*, and is well calculated to show the difficulty of diagnosis which is sometimes met with. The tumor, which was stated to have followed a misstep made some eight months before his presenting himself for examination, was situated in the right iliac region of a man aged 54. It was tense, pulsated obscurely throughout its whole extent, and offered a distinct bellows sound upon the application of the stethoscope. Believing that an aneurism existed, Mr. S. made an incision into the abdomen, six inches in length, with the intention of securing the external or common iliac, but when exposed, the tumor was found to be composed of a solid cerebriform mass, and was taken away entire. Seven days after it the patient died, and on dissection, a chain of tumors similar in nature was found surrounding the great vessels on both sides.

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[1] Elements of Surgery, p. 135. Amer. edit., 1845.

INTERNAL ILIAC ARTERY.—I am aware of only seven instances in which this vessel has been ligatured. These were by Stevens, Atkinson, Thomas, White, Arendt, Mott, and J. K. Rodgers. Of these, three died, and four were cured. In all of them the operation was done for the cure of aneurisms, and in one of them (Mott), although the peritoneum was opened in the efforts to separate it from the parts beneath, yet the patient did well.

COMMON ILIAC ARTERY.—Fifteen cases are recorded in which the operation of tying the primitive iliac has been performed. The first case in which it was done was that of a gunshot wound, in 1812, by Dr. W. Gibson, of this city. The patient died from peritoneal inflammation and secondary hemorrhage on the thirteenth day. The second case was that of Dr. Mott, for aneurism, in 1827, and was fully successful. The third was in 1828, by Mr. Crampton, also for aneurism, and was unsuccessful, the patient dying on the fourth day from hemorrhage. The fourth case was that of a boy, aged eight, in whom the common iliac was tied by Mr. Liston, in 1829, in consequence of secondary hemorrhage after amputation, and was unsuccessful. The fifth was the case of a lady operated on in 1833, by Mr. Guthrie, for a tumor on the right nates as large as an adult head, which presented so decidedly the characters of aneurism that it was believed to be so by Mr. G., as well as by Sir Astley Cooper and others, who examined it. Pulsation was manifest in every part of it, and "on putting the ear to it, the whizzing sound attendant on the flowing of blood into an aneurism could be very decidedly heard." Diminution of the tumor to the extent of one-half followed, and recovery from the operation was complete. Five months after it the tumor again enlarged, and she gradually sunk. On post-mortem examination, eight months after the operation, the arteries were found to be perfectly healthy and the tumor to consist of cerebriform matter. The sixth was by Mr. Salomon, of St. Petersburg, in 1837. The cure was deemed perfect, the tumor almost disappeared, and the free use of the limb was restored. Ten months after, the patient is stated to have taken cold, and had an abscess to form upon the affected side, which was opened just below Poupart's ligament. He died shortly after, worn out by the suppuration. The seventh case was that of Mr. Syme, in 1838, for aneurism, and was unsuccessful, the patient dying on the fourth day. The eighth was by Deguise of Paris, in 1840, and proved successful, despite three serious accidents which happened during its performance, viz., the wounding of the sac, the giving way of the vessel under a first ligature, and the wounding of the femoral vein in the taking up of the artery of that name which was done at the same time to prevent secondary hemorrhage. The ninth was in a case of aneurism, aged twenty, which occurred to Dr. Post, of New York, in 1840. The symptoms here were deceptive, and it being judged that deep fluctuation was present, an explorative incision was made into it. On the following night there was a sudden gush of arterial blood, which was arrested by compression, and the day after, a ligature was applied to the common iliac by cutting through the peritoneum, the tumor extending so high up that it was thought impracticable to expose the vessel without it. The patient sunk twenty-four hours after the operation, from exhaustion and loss of blood. The tenth case was that of a female child, aged two months, in whom the artery was secured by the late Dr. Bushe, on account of a large aneurism by anastomosis of the left labium. The child lived five weeks. In the eleventh case the ligature was applied by Dr. Pirogoff on account of hemorrhage after the removal of a ligature from the external iliac, which had been applied for the cure of aneurism. In exposing the vessel, the peritoneum, which was adherent, was torn through. The wound became gangrenous, and on the eleventh day, fecal matter was discharged through it. On the fourteenth day hemorrhage occurred, and the patient died twenty-four hours after it. The twelfth case was that of my colleague at the Pennsylvania Hospital, Dr. Peace. The operation was done in August, 1842. The tumor, which extended from three inches below to the same distance above Poupart's ligament, had become, five months after the operation, reduced to the size of a filbert, and was perfectly hard. On the 13th of November, 1843, he presented himself for readmission at the hospital, and stated that after being last seen he had returned to his employment—that of loading boats with stone—and had continued perfectly well and able to work up to within two weeks, when his attention was directed to a reappearance of his tumor. Upon examination it was found to be of the size of a small orange, was soft, entirely free from pulsation, presenting evident marks of fluctuation, and the skin covering it discolored. A few days afterwards an opening took place in it and was followed by considerable hemorrhage, which was arrested by compression. Several recurrences of this followed, and he died on the 24th. The thirteenth case was an aneurism operated on by Mr. R. Hey in 1843, and was successful. The fourteenth is the interesting case of supposed aneurism which has been published by Mr. Stanly. On applying the ear over the abdominal parietes, a bellows sound in the tumor was plainly recognized. Compression applied to the femoral artery below the tumor produced enlargement of it, but when made upon the aorta, all pulsation was arrested; after the application of the ligature to the common iliac, pulsation ceased. Death occurred on the third day from peritonitis. Upon dissection the arteries were found to have no connection with the tumor, which was composed of medullary matter. Tumors of a similar character were found in the heart and lungs, and one of the size of an orange occupied the middle and inner side of the arm, which during life was observed to be free from pulsation or pain, and was said to have existed for several years. The fifteenth and sixteenth cases are those which have been published by Dr. Garviso of Monte Video. The first, which occurred in 1837, was an aneurism of the external iliac which extended from the pubis to the umbilicus, and was of the size of an adult's head. An eschar which had formed on the tumor had commenced to separate and gave rise to abundant hemorrhage immediately previous to the performance of the operation. From the size and situation of the tumor the cavity of the peritoneum was necessarily opened. Death followed in four hours. The second of his cases—also an aneurism—was in 1843. The incision was made with a view of securing the external iliac, but the disease was found to extend so high up that the common trunk was tied. The ligature separated on the thirty-sixth day, and the patient recovered. Total, sixteen cases, of which eight may be said to have been successful, and eight died.

MORTALITY FOLLOWING THE LIGATURE OF THE CAROTID ARTERIES AND ARTERIA INNOMINATA.

Close examination of the cases recorded in the present tables shows that the operation of deligating the carotid has been too generally looked upon as one of but comparatively little danger; an analysis of them proves that serious symptoms frequently follow the mere cutting off of the supply of blood to the brain through this vessel, at the same time that it strikingly exhibits the frequency and severity of the other accidents which follow it, and throws some light upon the rate of mortality attendant upon operations on the great vessels of the neck.

III. Mortality following the Operation of Tying

SERIES I.—

No.	Surgeon.	Sex.	Age.	Right or left side.	Disease.	Duration of disease.	Ligature separated.
1	Cooper	F.	44	Right side	Aneurism	5 months	11th day
2	Cooper	M.	50	Left side	Aneurism	7 months	22d and 23d days
3	Cline	M.	...	....	Aneurism	....	....
4	Macaulay	M.	36	Left side	Aneurism from wound	5 days	....
5	Post	M.	35	Right side	Aneurism	10 months	16th and 18th days
6	Dupont	M.	27	Left side	Aneurism	6 months	....
7	....	F.	...	....	Aneurism from wound	6 weeks	14th day
8	Coates	M.	41	Left side	Aneurism	6 months	....
9	Porter	F.	40	Right side	Aneurism	15 years	19th day
10	Vincent	M.	52	Right side	Aneurism	3 weeks	22d day
11	Holscher	M.	23	Right side	Aneurism	....	15th day
12	Perry	M.	39	Right side	Aneurism	2 years	13th day
13	Sykes	F.	18	Right side	Aneurism	3 years	10th day
14	Key	M.	40	....	Aneurism	5 months	7th day
15	Warren	M.	42	Left side	Aneurism	4 years	....
16	Lisfranc	F.	...	Right side	Supposed aneurism	....	....
17	Scarpa	F.	29	Right side	Aneurism	....	21st day
18	Vincent	M.	48	Right side	Aneurism	8 months	....
19	Maurin	M.	40	Left side	Aneurism	1 month	....
20	Sisco	M.	17	Left side	Aneurism from wound	2 or 3 weeks	14th day
21	Lyford	M.	36	....	Aneurism	3 weeks	27th day
22	Chiari	M.	28	Left side	Aneurism from wound	....	....
23	Green	M.	65	Right side	Aneurism	5 months	24th day
24	Dehane	F.	10	Right side	Aneurism from wound	....	11th day
25	Marchal	M.	25	Left side	Aneurism from wound	2 months	....
26	Randolph	M.	25	Right side	Varicose aneurism	....	....
27	Robertson	M.	52	Right side	Aneurism	2 months	17th day
28	Porter	M.	38	Left side	Aneurism	5 weeks	15th day
29	B. Cooper	M.	34	Right side	Aneurism	12 months	33d day
30	Kerr	F.	67	Right side	Supposed aneurism	....	26th day
31	Liston	M.	9	Right side	False aneurism	2 months	....
32	Johnson	M.	29	Right side	Aneurism	5 weeks	22d day
33	Syme	F.	60	....	Aneurism of internal carotid	5 months	....
34	Fairfax	F.	...	Left side	Aneurism	....	....
35	Eccles	M.	46	Right side	Supposed aneurism	....	....
36	Duncan	F.	30	Right side	Aneurism	....	....
37	O'Reilly	M.	44	Right side	Supposed aneurism	2 years	....
38	White	M.	34	Right side	Aneurism	3 months	10th day

the Carotid Arteries and Arteria Innominata.

ANEURISMS.

Date of operation.	Result.	Period of death.	Cause of death.	Work.
November 1, 1805	Died	21st day	Inflammation of sac	Med. Chirurg. Transacts., vol. i.
June 22, 1808	Cured	....	....	Med. Chirurg. Transacts., vol. i.
Dec. 16, 1808	Died	4th day	Hemorrhage	Lond. Med. Review, vol. ii.
Dec. 16, 1812	Cured	....	....	Edin. Med. and Surg. Journ., vol. x.
January 9, 1813	Cured	....	....	Amer. Med. and Phil. Register, vol. iv.
1814	Cured	....	....	Breschet's Trans. of Hodgson, tom. ii.
....	Cured	....	....	Hodgson on the Arteries, 1815.
January 3, 1817	Died	70th day	Hemorrhage	Med. Chirurg. Transacts., vol. xi.
August 21, 1829	Cured	....	....	Dub. Hosp. Reports, vol. v.
Dec. 19, 1818	Died	33d day	Inflammation of sac	Med. Chirurg. Transacts., vol. x.
Sept. 27, 1819	Cured	....	....	Lond. Med. Repository, vol. xvi.
Nov. 14, 1820	Cured	....	....	Glasgow Med. Journ., vol. iv.
June 20, 1821	Cured	....	....	Phila. Journ., vol. vi.
January 24, 1824	Died	10th day	....	Lancet, vol. i., 1823–4.
October 26, 1827	Cured	....	....	Boston Med. & Surg Journ., vol. i.
1827	Died	8th day	Hemorrhage	Am. Journ. of Med. Sci , vol. ii.
May 23, 1828	Cured	....	....	Lancet, vol. i., 1828–9.
July 18, 1829	Died	7th day	Inflammation of brain	Med. Chirurg. Transacts., xxix.
Nov. 20, 1829	Cured	....	....	Lond. Med. & Phys. Journ., vol. viii., N. S
....	Cured	....	....	Archives Générales, tom. vol. xxiii.
October 30, 1818	Cured	....	....	Med. Chirurg. Transacts., vol. xi.
July 18, 1829	Died	9th day	....	Méd. Opérat. of Velpeau, tom. 2, 1839.
April 15, 1831	Recovered	....	....	Dublin Journ. and South's Trans. of Chelius.
January 20, 1832	Cured	....	....	Am. Journ. of Med. Sci., vol. x.
June 19, 1835	Died	6th day	....	Journal Hebdomadaire, tom. iv.
1836	Died	day after	Congestion of brain	At Pennsylvania Hospital.
March 21, 1837	Cured	....	....	Dublin Journal, vol. xii.
Sept. 22, 1838	Died	6 wk's after	Hemorrhage	Dublin Journal, vol. xvii.
April 7, 1840	Cured	....	....	Guy's Hospital Reports, No. 13, 1841.
April 30, 1840	Recovered	....	....	Edin. Med. & Surg. Journ., vol. lxi.
October 21, 1841	Died	15th day	Hemorrhage	On a variety of False Aneurism, 1842.
January 22, 1842	Cured	....	....	Lond. Med. Gazette, vol. ii., 1841–2.
April, 1842	Died	in 30 hours	....	London and Edin. Monthly Journ., 1842.
July 18, 1842	Died	5th day	Exhaustion	Phila. Medical Examiner, vol. vi.
Sept. 23, 1843	Recovered	....	....	Lancet, 1844.
Dec. 25, 1843	Died	17th day	Spasm of glottis	Edin Med. & Surg. Journ., vol. lxii.
July 20, 1844	Died	9th day	Apoplexy	Dublin Medical Press, Oct. 1844
August 28, 1845	Cured	....	....	Lancet, February, 1846.

SERIES II.—

No.	Surgeon.	Sex.	Age.	Right or left side.	Disease.	Duration of disease.	Ligature separated.
1	Fleming	M.	...	....	Hemorrhage after wounded throat	....	....
2	Abernethy	M.	...	Left side	Wounded throat	....	....
3	Twitchell	M.	20	Right side	Hemorrhage after wounded neck	10 days	13th day
4	Dupuytren	M.	42	Right side	Hemorrhage after gunshot wound	22 days	....
5	Marjolin	M.	20	....	Hemorrhage after gunshot wound	6 days	....
6	Giroux	...	...	....	Hemorrhage after gunshot wound	....	....
7	Collier	M.	29	Left side	Hemorrhage after wound at angle of jaw	5th day	13th day
8	Travers	M.	...	Right side	Hemorrhage from fungous tumor of cheek	....	....
9	Brodie	M.	27	Left side	Hemorrhage following extraction of a tooth	....	....
10	Brown	M.	35	Right side	Hemorrhage after wounded throat	7 days	12th day
11	Cusack	M.	36	....	Wounded throat	....	21st day
12	Boileau	M.	36	Right side	Wounded throat	....	....
13	De Cruz	M.	44	Left side	Wounded throat	....	....
14	Miller	F.	...	....	Hemorrhage after wounded throat	27 days	....
15	Travers	M.	35	Right side	Wounded throat	....	13th day
16	Mayo	M.	23	Right side	Hemorrhage from ulcer in throat	....	15th day
17	Luke	M.	45	Left side	Hemorrhage from ulcer in throat	....	22d day
18	Langenbeck	M.	29	....	Hemorrhage after tying thyroids for goitre	....	....
19	Horner	M.	34	Right side	Wounded throat	....	24th day
20	Syme	M.	9	Left side	Hemorrhage from ear and fauces	....	....
21	Tyerman	M.	35	Right side	Wounded throat	....	11th day
22	Mayo	M.	30	Right side	Hemorrhage after wounded throat	8 days	....
23	Ellis	M.	28	....	Hemorrhage after wounded throat	8 days	9th day
24	Bedor	M.	20	Left side	Hemorrhage after wounded throat	....	14th day
25	Duncan	M.	60	Left side	Hemorrhage from ulcer in throat	....	....
26	Sédillot	M.	19	Right side	Hemorrhage following wound of ext. carotid	13 days	....
27	Spence	M.	38	Left side	Hemorrhage from ulceration of face	....	....
28	Peace	M.	22	Right side	Hemorrhage from ulceration behind jaw	....	12th day
29	Vincent	M.	28	Right side	Hemorrhage after wounded tongue	8 days	....
30	Clark	M.	29	Left side	Wound of external carotid	....	16th day

WOUNDS, ETC.

Date of operation.	Result.	Period of death.	Cause of death.	Work.
October 17, 1803	Cured	....	....	Med. Chir. Review, Jan. 1827.
....	Died	30 hours after	Inflammation of brain	Surgical Works, vol. ii.
October 18, 1807	Cured	....	....	New Eng. Quart. Journ. of Med. and Surg., Oct. 1842.
February 24, 1814	Died	6th day	....	Breschet's Trans. of Hodgson, tom. ii.
1814	Died	2d day	Hemorrhage	Breschet's Trans. of Hodgson, tom. ii.
1814	Died	9th day	Effusion of blood at base of brain	Breschet's Trans. of Hodgson, tom. ii.
June 22, 1815	Cured	....	....	Med. Chir. Transacts., vol. vii.
April 13, 1816	Died	16th day	....	Lond. Med. and Phys. Journ., April 1827.
July 5, 1816	Died	2d day	....	Med. Chir. Transacts., vol. viii.
June 14, 1817	Cured	....	....	Dublin Hospital Reports, vol..i.
August 16	Died	60th day	Hemorrhage	Dub. Hosp. Rep., vol. iii.
July 22, 1822	Cured	....	....	North American Med. & Surg. Journ., vol. i.
February 27, 1825	Cured	....	....	Boston Med. & Surg. Journ., vol. ii
October 9, 1825	Cured	....	....	Western Journal, vol. i.
June 27, 1826	Died	58th day	Hemorrhage	Lond. Med. and Phys. Journ., vol. i., N. S.
October 19, 1828	Cured	....	....	North American Med. & Surg. Journ., April, 1830.
October 4, 1829	Cured	....	....	London Medical Gazette.
1829	Died	24 hours after	Inflammation of brain	Archives Générales, tom. xix.
June 18, 1832	Cured	....	....	Am. Journ. of Med. Sci., vol. x.
Sept. 18, 1832	Cured	....	....	Edin. Med. and Surg. Journ., vol. xxxviii.
August 14, 1834	Cured	....	....	Med. Chir. Review, vol. xxiv., N. S.
1834	Died	13th day	Inflammation of brain	Medical Quarterly Review, vol. i.
January 26, 1835	Cured	....	....	Lancet, vol ii., 1834–5.
April 24, 1835	Cured	....	....	La Presse Médicale, No. x.
March 29, 1836	Died	14th day	Bronchitis	Edin. Med. & Surg. Journ., vol. lxii.
April 1842	Died	10th day	....	Gazette Médicale, No. xxxvi., 1842.
May 29, 1842	Died	61st day	Exhaustion	London & Edin. Monthly Journal, vol. ii.
November 8, 1844	Died	31st day	Hemorrhage	At Pennsylvania Hospital.
April 16, 1845	Died	6th day	Hemorrhage	Medico-Chirurg. Trans., vol. xxix.
October 14, 1846	Cured	....	....	Lond. Med. Gazette, Feb. 1847.

SERIES III.—EXTIRPATION

No.	Surgeon.	Sex.	Age.	Right or left side.	Disease.	Duration of disease.	Ligature separated.
1	Cogswell	F.	37	Left side	Parotid tumor	6 months	14th day
2	Goodlad	F.	...	Left side	Parotid tumor	....	11th day
3	Mott	M.	49	Right side	Fungous tumor in neck	....	14th day
4	Mott	F.	17	Right side	Osteo-sarcoma of jaw	2 years	15th day
5	Mott	F.	22	Left side	Osteo-sarcoma of jaw	1 year	14th day
6	Mott	M.	18	Right side	Osteo-sarcoma of jaw	6 years	....
7	Awl	F.	12	Right side	Ossific tumor of jaw	18 months	....
8	Fouilloy	F.	52	Left side	....	....	15th day
9	Stedman	M.	58	Right side	Parotid tumor	12 years	26th day
10	Scott	M.	45	Right side	Tumor of face	4 months	....
11	Ewing	M.	52	Right side	Tumor in neck	30 years	....
12	Mott	F.	19	....	Tuberculated sarcoma of neck	5 years	....
13	Gibson	M.	17	Left side	Medullary tumor in neck	5 years	36th day
14	Luzenburg	M.	62	Left side	Parotid tumor	20 years	....
15	Warren	M.	52	Right side	Scirrhous tumor in neck	30 years	....
16	Roux	F.	30	Right side	Parotid tumor	2 years	....
17	Brett	F.	17	....	Parotid tumor	5 years	....
18	C. B. Gibson	F.	35	Right side	Osteo-sarcoma of jaw	6 years	22d day

SERIES IV.—CEREBRAL

No.	Surgeon.	Sex.	Age.	Right or left side.	Disease.
1	Liston	F.	24	Left side	"Beating pain in left cheek and jaw, stretching to the throat, and, indeed, involving whole head"
2	Becton	M.	22	Left side	Epilepsy
3	Preston	M.	50	Right side	Hemiplegia of left side
4	Preston	M.	25	....	Epilepsy
5	Preston	M.	51	Right side	Epilepsy and hemiplegia
6	Preston	M.	24	Right side	Headache and partial paralysis

OF TUMORS.

Date of operation.	Result.	Period of death.	Cause of death.	Work.
Nov. 4, 1803	Died	20th day	Hemorrhage	New England Journ. of Med. and Surg., vol. xiii., 1824.
Sept. 5, 1815	Cured	....	....	Medico-Chirurg. Trans., vol. vii.
Nov. 14, 1818	Died	3 mos. & 19 days after	....	Med. & Surg. Register, Part 2d.
Nov. 18, 1821	Cured	....	....	New York Med. and Phys. Journ., vol. i.
March 30, 1823	Cured	....	. ...	New York Med. and Phys. Journ., vol. ii.
May 15, 1823	Died	4th day	Inflammation of chest	New York Med. and Phys. Journ., vol. ii.
1827	Cured	....	....	Western Journal, vol. i.
1828	Cured	....	....	Archives Générales, tom. xviii.
Sept. 7, 1830	Cured	....	....	Medico-Chirurg. Review, vol. xvi., N. S.
Feb. 4, 1832	Died	42 hours after	Convulsions	London Medical Gazette, vol. ix., 1832.
Feb. 11, 1832	Died	4th day	"Gradually sunk"	Edin. Med. and Surg. Journal, vol. xxxviii.
February 1832	Cured	....	....	Am. Journ. of Med. Sci., vol. xii.
Nov. 20, 1832	Cured	....	....	Am. Journ. of Med. Sci., vol. xiii.
1834	Cured	....	....	Annales de Chirurgie, tom. vi.
March 7, 1837	Recovering on 8th day	....	....	On Tumors, p. 183.
June 19, 1837	Died	14th day	....	Gaz des Hôpitaux, 1837.
....	Cured	....	....	India Journ. of Med. & Phys. Sci., August 1839.
June 12, 1844	Cured	....	....	Am. Journ. of Med. Sci., vol. viii., N. S.

AFFECTIONS.

Duration of disease.	Ligature separated.	Date of operation.	Result.	Work.
....	22d day	June 22, 1817	Recovered	Edin. Med. and Surg. Journ., vol. xvi.
9 years	....	Mar. 21, 1827	Recovered	North American Med. & Surg. Journ., vol. iv.
1 month	18th day	Nov. 22, 1830	Recovered	Transacts Med. Phys. Soc. of Calcutta, vols. v. & vi.
5 years	29th day	Feb. 4, 1831	Recovered	Transacts. Med. Phys. Soc. of Calcutta, vols. v. & vi.
Fits 6 years, palsied 20 days	....	Aug. 23, 1831	Recovered	Transacts. Med. Phys. Soc of Calcutta, vol. vi.
....	....	Sept. 2, 1831	Recovered	Transacts. Med. Phys. Soc. of Calcutta, vol. vi.

SERIES V.—ERECTILE TUMORS, TUMORS OF

No.	Surgeon.	Sex.	Age.	Right or left side	Disease.	Duration of disease.	Ligature separated.
1	Travers	F.	34	Left side.	Erectile tumor in orbit	4 years & 5 months	21st and 22d days
2	Dalrymple	F.	44	Left side	Erectile tumor in orbit	9 months	27th day
3	Wardrop	..	six w'ks	Left side	Erectile tumor in cheek	6 weeks	......
4	Dupuytren	M.	20	Right side	Erectile tumor of ear and temple	....	12th day
5	Jameson	M.	26	....	Fungus of the antrum	13 months	......
6	Arendt	M.	35	Right side	Erectile tumor of face	....	17th day
7	Pattison	M.	18	Left side	Erectile tumor of face	8 years	......
8	Davidge	M.	..	Left side	Fungus of the antrum	....	......
9	Finley	M.	..	Right side	Fungus of the antrum	some months	......
10	Barovero	M.	..	Right side	Tumor behind the jaw	....	19th day
11	McClellan	F.	5	Left side	Erectile tumor in orbit	4½ years	14th day
12	McClellan	F.	9	Left side	Erectile tumor of cheek	....	14th day
13	McClellan	M.	16	Right side	Vascular fungus from dura mater	....	about 2 weeks
14	Wardrop	F.	five mos.	Left side	Erectile tumor of face	....	11th day
15	Frick	..	..	....	Cancer of parotid	....	......
16	Mayo	M.	26	Right side	Fleshy tumor of neck	....	17th day
17	Magendie	F.	25	Left side	Tumor of maxillary sinus	....	11th day
18	Wardrop	M.	22	Left side	Erectile tumor of face and head	12 years	25th day
19	Maclachlan	M.	30	Left side	Pulsating tumor on scalp	....	......
20	Willianme	M.	24	Left side	Fungous tumor on temple	....	21st day
21	Warren	F.	18	Right side	Erectile tumor in orbit	....	......
22	Bushe	M.	19	Left side	Erectile tumor on inside of cheek	from birth	29th day
23	D. L. Rogers	..	eight mos.	Right side	Erectile tumor of face	from birth	......
24	Mayo	M.	five mos.	Left side	Erectile tumor of face	....	8th day
25	Mighels	F.	23	Left side	Erectile tumor of face and occiput	2 years	30th day
26	Velpeau	M.	16	Left side	Erectile tumor of temporal fossa	....	......
27	Chelius	M.	19	Right side	Aneurismal varix of temple	1 year	21st day
28	Busk	M.	20	Right side	Erectile tumor in orbit	6 months	13th day
29	Scott	M.		Right side	Erectile tumor in orbit	1 month	......
30	Miller	F.	42	Right side	Erectile tumor in orbit	18 months	......
31	Pirogoff		nine mos.	Left side	Erectile tumor on occiput	9 months	removed on 8th day
32	Zeiss		fifteen mos.	Left side	Erectile tumor of face	15 months	8th day
33	Jobert	M.	..	Right side	Erectile tumor in orbit	3 years	1 month after
34	Auchinloss	F.	23	Left side	Erectile tumor on temple	from birth	19th day
35	Velpeau	M.	..	Right side	Erectile tumor in orbit	....	......
36	Caldwell	F.	60	Right side	Erectile tumor in orbit	1 year	39th day
37	Dudley	M.	..	Right side	Erectile tumor in orbit	several years	......
38	Blackman	M.	30	Right side	Fungous tumor of neck	2 years	......
39	Liston	M.	20	....	Arterial varix of scalp	....	......
40	A. C. Post	M.	27	Right side	Erectile tumor of cheek	spot from birth, but increasing for 3 years	......
41	Bos	F.	17	Right side	Tumor of the diploe	20 months	......
42	Petrequin	M.	22	Left side	Erectile tumor in orbit	5 months	......

DIPLOE, JAW, MAXILLARY SINUS, AND NECK.

Date of operation	Result.	Period of death.	Cause of death.	Work.
May 23, 1809	Cured	.....	....	Med. Chirurg. Trans., vol. ii.
......				
April 7, 1813	Cured	.....	....	Med. Chirurg. Trans., vol. vi.
......	Died	14th day	Irritation of ulcer	Med. Chirurg. Trans., vol. ix.
April 8, 1818	Recov.	.....	....	Leçons Orales, tom. iv.
Nov. 11, 1820	Cured	.....	....	Philad. Med. Recorder, vol. iv.
Nov. 8, 1821	Cured	.....	....	Lancet, 1828–9.
1821	Cured	.....	....	Burns' Anat. of Head and Neck, 1823.
April, 1823	Died	6 weeks	Lock-jaw	Burns' Anat. of Head and Neck, 1823.
July 27, 1824	Recov.	.....	....	Maryland Medical Recorder, vol. i.
May 19, 1825	Died	69th day	Inflammation of brain	Journ. de Physiologie, tom. vii.
June 10, 1825	Cured	.....	....	N.Y. Med. & Phys. Jour., vol. v.
1825	Cured	.....	....	N.Y. Med. & Phys. Jour., vol. v.
1825	Cured	.....	....	N.Y. Med. & Phys. Jour., vol. v.
March, 1826	Cured	.....	....	Lancet, vol. xii.
1826	Died	.....	Long-continued constitutional disturbance occasioned by disease.	Lancet, vol. xii.
Jan. 20, 1827	Recov.	.....	....	Lond. Med. and Phys. Journ., vol. v., N. S.
March 4, 1827	Recov.	.....	....	Jour. de Physiologie, tom. vii.
1827	Cured	.....	....	Lancet, vols. xii. and xiii.
July 10, 1825	Died	4th day	Inflammation of chest	Glasgow Med. Jour., vol. i.
June 26, 1829	Recov.	.....	....	Jour. Univers. Hebdom., tom. iii.
Jan. 2, 1830	Cured	.....	....	On Tumors.
Jan. 15, 1830	Cured	.....	....	Med. Chirurg. Bulletin, vol. i.
Dec. 12, 1832	Cured	.....	....	Amer. Jour. of Med. Sci., vol. xii.
......	Recov.	.....	....	Med. Quarterly Review, vol. i.
Mar. 12, 1835	Cured	.....	....	Boston Med. and Surg. Jour., vol. xx.
1835	Died	16th day	Repeated hemorrhages	Méd. Opératoire, tom. ii., 1839.
Jan. 18, 1836	Recov.	.....	....	Gabe on Aneurismal varix, 1844.
Feb. 2, 1836	Cured	.....	....	Med. Chirurg. Trans. vol. xxii.
Nov. 10, 1836	Cured	.....	....	Med. Chirurg. Trans. vol xxii.
1836	Died	8 days after	Apoplexy	Lond. & Edin. Monthly Jour., vol. ii.
Jan. 26, 1837	Died	117 days after	Hemorrhage	Revue Médicale, 1838.
Aug. 30	Died	114 days after	Convulsions	Revue Médicale, 1838.
Aug. 7, 1839	Cured	.....	....	Gazette Médicale, 1840.
July 7, 1839	Cured	.....	....	London Medical Gazette, vol. i., 1842–3.
1839	Recov.	.....	....	Gazette Médicale, 1840.
Sept. 16, 1840	Cured	.....	....	Boston Med. and Surg. Jour., vol. xxiv.
Jan. 1841	Cured	.....	....	Transactions of College of Physicians of Philada., 1842.
June 21, 1843	Died	8th day	Long-continued constitutional disturbance	Amer. Jour. of Med. Sci. vol. x., N. S.
......	Died	10 days after	Hemorrhage	Lancet, 1844.
April 12, 1845	Died	.....	Phlebitis of internal jugular	New York Jour. of Medicine, vol. v.
......	Died	.....	Diarrhœa & hemorrh'ges	Archives Générales, 1845.
June 5, 1845	Recov.	.....	....	Gazette Médicale, 1846.

SERIES VI.—BRASDOR'S OPERATION.

No.	Surgeon.	Sex.	Age	Right or left side.	Disease.	Date of operation.	Result.	Period of death	Cause of death.	Work.
1	Wardrop	F.	75	Right	Aneurism of root of carotid	June, 1825	Rocovered	....	....	On Aneurism
2	Wardrop	M.	57	Right	Aneurism of root of carotid	Dec. 10, 1826	No improvement	....	....	On Aneurism
3	Lambert	F.	49	Right	Aneurism of root of carotid	March 1, 1827	Recovered	....	....	On Aneurism
4	Bush	F.	36	Right	Aneurism of root of carotid	Sept. 11, 1827	Recovered	....	....	On Aneurism
5	Evans	M.	30	Right	Aneurism of arteria innominata and root of carotid	July 22, 1828	Recovered	....	....	Villardebo Thèse
6	Montgomery	M.	40	Left	Supposed aneurism of carotid	March 10, 1829	Recovered	....	....	Med. Chirurg. Review, Jan. & April, 1830
7	Mott	M.	51	Right	Aneurism of arteria innominata	Sept 26, 1829	Recovered	....	....	Am. Journ. of Med. Sci., vols. v. & vi.
8	Wickham	M.	55	Right	Aneurism of arteria innominata	Sept. 26, 1829	Recovered	....	....	Lancet, 1840
9	Key	F.	61	Right	Aneurism of arteria innominata	July 20, 1830	Died	A few hours after operat'n	want of am't of blood necessary to innervation	Lond. Med. Gazette, July, 1830
10	Morrison	M.	42	Right	Aneurism of arteria innominata and root of carotid	Nov. 8, 1832	Recovered	....	....	Am. Journ. of Med. Sci., vol. xix.
11	Fearn	F.	28	Right	Aneurism of the innominata	Aug. 30, 1836	Recovered	....	....	Lancet, 1836-8
12	Colson	F.	63	Left	Aneurism of root of carotid	1839	Recovered	....	....	Gaz. Médicale, Sept. 1840, & Mems. French Acad., 1841
13	Fergusson	M.	56	Right	Aneurism of arteria innominata & root of subclavian	June 22, 1841	Died	7th day	Pleuro-pneumonia	Am. Journ. of Med. Sci., vol. iii., N. S.
14	O'Shaughnessy	M.	42	Right	Aneurism of aorta, supposed to be of the root of carotid and innominata.	....	Died	10th day	Rupture of aorta	Gaz. Médicale, No. xviii., 1843
15	Campbell	M.	48	Right	Supposed aneurism of arteria innominata	March 8, 1845	Died	19th day	Pneumonia	Lond. & Edin. Monthly Jour. 1845

REMARKS.

1. Progressive diminution of tumor after operation till the 5th day, when it increased, inflamed, suppurated, and ulcerated. Upwards of three years after the operation the patient continued to enjoy good health.

2. Tumor did not diminish after operation. About three weeks after it the swelling increased, and its pulsations became stronger. Patient died March 23, 1827. On dissection the heart was found hypertrophied. *The carotid artery was found to be completely pervious*, and could hardly have been tied.

3. Tumor diminished in size, and finally entirely disappeared. Five weeks after operation the wound, which had healed, re-ulcerated. April 18,

hemorrhage from wound, which was repeated at intervals till 23d; again on 1st of May, when she died. On dissection pericarditis and dilatation of aorta. Sac filled with coagulum. Carotid thickened, and lower part of it completely closed. Just above where the ligature was applied an ulcerated opening of it existed.

4. The tumor was very large and suffocation imminent. After the operation it rapidly diminished. On 27th day after it the wound was healed, and the tumor was reduced to one-half its former bulk. Patient was alive and well in March, 1830.

5. Pulsation stronger on 23d. By 22d October tumor had diminished one-third, was hard, and pulsation scarcely perceptible in it. On 8th August, 1830, tumor suppurated and discharged about oz. xxiv of pus mixed with a number of hairs. The opening was enlarged, and two fleshy tumors, of the size of a small pullet's egg, were brought into view by it, having on their surface several hairs analogous to those which had been discharged. A ligature was put around that which first presented, as low as possible behind the sternum, and it was allowed to slough off. The second was also tied, and then removed by the knife close to the ligature. After this the cavity of the sac contracted, and by end of November was completely cicatrized. On 16th May, 1831, she enjoyed perfect health, and all trace of tumor had disappeared.

6. By 14th March the tumor was reduced to half its size, but on 28th again enlarged, and on 29th May gave way and discharged oz. viij of dark fetid fluid. On following day the opening was enlarged and gave exit to coagula. On 3d July expectorated oz. vj of fluid blood, and died on 12th. Dissection showed no vestige of sac remaining. Left carotid was obliterated from the bifurcation to aorta. A distinct aneurism of aorta, of the size of an orange, existed between the arteria innominata and the left carotid.

7. The pulsation in and size of tumor gradually diminished after the operation, and by 16th of October both had entirely disappeared. The patient died from suffocation April 22, 1830. Dissection showed the right carotid to be obliterated. No tumor externally, internally was of the size of the two fists.

8. Immediately after the operation the tumor grew less, and the pulsation in it diminished. In December the tumor was increasing rapidly, and was more than double its original size, and on the 3d of that month the subclavian was tied. This operation was followed by relief of symptoms, but the tumor continued slowly to increase. He died 16th Feb. 1840, from bursting of the sac. Dissection showed the aneurism to be seated in the innominata. The aorta was dilated and studded with osseous plates.

9. On autopsy found aneurism of the innominata and of the cross of the aorta. The left carotid was almost obliterated, and the vertebrals smaller than in the natural state.

10. Afternoon of operation pulsation in the tumor "was tremendous." After the 17th it became weaker, and tumor began to harden and diminish in size. He returned to his employment (charcoal maker), and dropped down dead 20 months after the operation. The arteria innominata was double its natural size, and studded with spiculæ of ossific matter. Right carotid, from its origin to point at which ligature had been applied, was dilated into a sac, which was plugged up by a dense fibrinous deposit.

11. By 9th Sept. tumor had lessened considerably, and the pulsations were less distinct, and on 19th of same continued gradually diminishing. Two years after operation there was no appearance of tumor externally, but in consequence of a return in her symptoms a ligature was put round the subclavian (Aug. 2, 1838). From this she recovered, and her symptoms were mitigated. She died Nov. 27, 1838, of pleuritis, having lived two years and three months after ligature of the carotid. Dissection showed the innominata alone to be the seat of disease. The sac, except a channel of the usual size of the innominata, was filled by a dense, organized coagulum. The right carotid was permeable for about a third of an inch from its origin. Opposite the cricoid cartilage there was an interruption to its continuity, where the ligature had been applied. The upper portion of the vessel was impermeable to where the external carotid was given off.

12. Pulsation in tumor gradually diminished after operation. One year after it was the size of a small nut, and pulsation was scarcely perceptible in it. M. Robert, in his Thèse, states, that in June, 1842, the patient continued in a satisfactory state.

13. After the operation the tumor decreased, and its pulsations were weakened. On dissection the tumor was nearly filled with pretty firm clots of fibrin. No clot was found in the carotid even as high up as the ligature, which was placed one-fourth of an inch below the bifurcation.

14. Tumor did not diminish after the operation. On dissection the carotid was found obliterated, both above and below the ligature, by a firm clot. The ligature had been placed three-fourths of an inch below the bifurcation.

15. On tightening the ligature the swelling disappeared. After a short time it began gradually to return, though it did not nearly regain its original size. On 11th the tumor was the size of a walnut. Dissection showed the tumor to fill up the whole of the anterior and middle mediastinum in front of the root of the right lung, extending from the cartilage of the third rib to the top of the sternum. The aneurism commenced at root of innominata, involving nearly the whole of that vessel, and also the transverse portion of the arch of the aorta as far as the left carotid. The first bone of the sternum, end of clavicle, and first rib were denuded of periosteum, and formed part of the outer wall of the sac. Descending aorta was dilated as far as the diaphragm, and had ossified deposits. Left ventricle slightly hypertrophied.

SERIES I.—ANEURISMS.

Mortality.—Of the thirty-eight cases in this series, twenty-two recovered, and sixteen died.

Sex.—Of these thirty-eight cases, twenty-seven were males, and eleven females. Of the eleven females, two had aneurisms following wounds, seven labored under true aneurisms, and two had tumors in the neck which were mistaken for it.

Right or left side.—Of thirty-three cases in which the affected side is noted, twenty-two were on the right, and eleven on the left side.

Age.—This is mentioned in thirty-four of the cases, of which number there were under 20, four; between 20 and 30, seven; 30 and 40, eight; 40 and 50, nine; 50 and 60, three; 60 and 70, three.

Disease.—Of the thirty-eight operations contained in the series—thirty-three were done for the cure of aneurism—one was for the cure of varicose aneurism, and in four the tumors though supposed to be aneurisms were afterwards discovered not to be such.

Period the ligature separated.—In twenty-one of the cases in which this is noted, the ligature came away: in thirteen, before the twentieth day; in seven, between the twentieth and thirtieth days; and in one on the thirty-third day.

Return of pulsation in the tumor after the application of the ligature.—In nine of the thirty-eight cases, pulsation was noticed in the tumor after the operation. In one of these (No. 2), pulsation "did not wholly cease" after the application of the ligature, but continued for upwards of two months, the cure afterwards being perfect. In No. 10, pulsation became more faint, but did not entirely cease on tightening the ligature. Two days afterwards it was not perceptible, and the swelling diminished to one-fourth of its original size. In No. 13, the tumor was noticed to pulsate on the fourteenth day after the operation, and continued to do so four or five months. In Nos. 23, 28, and 33, pulsation never entirely left the tumors. In the first of these, aneurisms existed on both sides of the neck. Pulsation did not immediately cease on the application of the ligature, though it did in the course of the following hour; on the succeeding day, however, it recurred feebly, and continued diminishing till the seventeenth day, but never ceased. The patient recovered from the effects of the operation. The second died after repeated hemorrhages at the end of six weeks. The last (No. 33), was a woman aged sixty, affected with aneurism of the internal carotid. The tumor which had existed about five months, and had attained the size of a large walnut, was in the throat in the situation of abscess connected with the tonsil. It presented the diffused aspect of a purulent collection, and a strong and uniformly distending pulsation could be perceived over every part of it. After the artery was tied, pulsation continued in the tumor, but was much less forcible. The patient died in thirty hours. The operator adds, "though doubts might be entertained as to the cure of the disease, through want of sufficient obstruction in the flow of blood, no apprehension was entertained of danger from the operation, and I feel quite unable to offer any satisfactory explanation of its fatal issue." This case is highly interesting, as presenting an example of aneurism in a very unusual situation, and is accompanied by a drawing which shows very distinctly its position in regard to the artery. In No. 9, pulsation was observed in the tumor four hours after the operation and left it on the sixteenth day. In No. 15, pulsation in the tumor continued for a number of weeks—a cure taking place, and in No. 32, slight pulsation returned on the night of the operation, but afterwards entirely disappeared.

Hemorrhage after the operation.—All the cases in which this occurred, after the operation, but two proved fatal. In No. 12, the artery was tied on the 14th of November, and the hemorrhage had place on the 29th of December, and was arrested by firm pressure and low diet. In No. 38, it took place on the evening of the tenth day, to the amount of a pint, and was checked by pressure, but on the next day there was a recurrence of it, which ceased spontaneously.

Bursting of the tumor.—In six of the thirty-eight cases, the tumor suppurated, and either burst spontaneously or was laid open. Of these, four died, and two were cured. In No. 5, the opening in the sac took place nearly eight months after the operation, and in No. 9 there was an interval of about four months between these occurrences. In one case, which died, No. 36, the opening was in the pharynx fifteen days after the operation, and on the same day the tumor was laid open. In No. 27, the aneurism had ruptured into the mouth, previous to the operation, yet the patient did well.

Cause of death.—Of the thirty-eight cases operated upon for aneurisms, sixteen died. Of these, two died from inflammation of the sac; one from inflammation of the brain; five from hemorrhage coming on at periods between the fourth and seventieth days; one from spasm of the glottis; two from apoplexy and congestion of the brain; one from "exhaustion" on the fifth day; and in four the cause of death is not noted.

Mistakes in diagnosis.—In seven of the thirty-eight cases in the table, mistakes in diagnosis occurred. In No. 16, the tumor, on dissection, proved to be a fungus hæmatodes. In No. 37, the disease was carcinomatous. In No. 30, the aneurism was supposed to be cured, the patient living nine months after the operation, but on post-mortem examination, it was found to be a tumor surrounding, though in no way connected with the artery. In No. 35, the patient was also looked upon as cured of his aneurism, and died four months afterwards of bronchitis, when the disease was found to be a glandular swelling. In No. 25, the aneurism was mistaken for an abscess, and incised; repeated hemorrhages followed, and the external carotid was secured. This procedure failed to arrest the bleeding, and the common carotid was tied. The patient died on the sixth day. In No. 31, a boy nine years of age, the tumor was carefully examined to ascertain if pulsation existed, "a hint having been given that it might in some way be connected with the carotid," but not the slightest pulsation could be perceived in any part, except in the course of the vessel. Such being the case, a puncture was made in the tumor under the impression that it contained matter. A gush of arterial blood followed, and about four ounces were lost in a few seconds. The wound was closed by hare-lip pins and the twisted suture, and the bleeding checked. On the following day the carotid was tied close to the origin of the innominata. On the 3d of November, a sudden gush of arterial blood took place from the wound in the neck, the ligature being still firm. This was suppressed by plugging the wound with lint. Hemorrhage recurred six times after this, the last leaving him in a state of perfect collapse, and he died on the 5th. On dissection, the proximal end of the vessel was found to be quite open, and there had been no attempt at the formation of a clot. The operator, Mr. Liston, believes that the tumor was originally a scrofulous abscess accompanied with ulceration of the vessel, and consequent effusion of blood into the cyst; this, he thinks, was proved by the position and form of the cyst (plates of which are given), the nature of the lining membrane, the absence of lamellated coagula, and the kind of opening in the artery—it being very small, and the three coats being traceable to the margin of it. No. 22, was an aneurism following a wound of the vertebral artery alone, in which the common carotid was tied at the hospital of Naples. The tumor was seated below the mastoid process. The patient died on the ninth day, and the autopsy showed the aneurism to occupy the vertebral artery between the transverse processes of the first two cervical vertebræ. The vertebral artery being very rarely the seat of aneurism, it may be well to notice here a case somewhat similar to that just mentioned, which is recorded by M. Ramaglia, of Naples. The patient, aged thirty-nine, received a wound from a sharp-pointed instrument behind the left ear, which resulted in the formation of an aneurismal tumor in that situation. The common carotid was tied for its cure, but finding that this did not arrest pulsation in the tumor, the ligatare was removed. A short time after, the patient died, and dissection showed the aneurism to arise from the vertebral artery.[1]

Another example of aneurism of the vertebral artery is mentioned by Mr. South, in his translation of Chelius's Surgery, as having occurred in the Northern Infirmary at Liverpool; the carotid artery could be distinctly traced over the pulsating swelling, of the actual nature of which there were some doubts as to what kind of aneurism it was, or whether only a pulsating tumor. It was decided to tie the common carotid artery. The tumor rapidly increased after the operation, and in about a fortnight the patient died by the bursting of the aneurism into the trachea. On post-mortem examination, an aneurism of the vertebral artery, between the transverse processes of the fourth and fifth cervical vertebræ, was found.

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[1] Velpeau, Méd. Opérat., tom. ii. p. 220.

The diagnosis of aneurismal tumors of the neck is acknowledged by all to be at times exceedingly difficult. An instance in which enlargement of the thyroid gland, as proved by dissection, was mistaken for an aneurism, has been reported by the late Dr. S. P. Griffitts. Wishing, he observes, "to think the disease was glandular, endeavors were frequently made to draw the tumor out from the artery, but without success, as it was so firmly fixed over the vessel as not to be moved from it, and the pulsation was such as to convey the idea that there was no intervening substance." The propriety of an operation had been suggested, to which objection was made from a belief that the artery below the clavicle was diseased. In the *Dictionnaire des Sciences Médicales*, tom. xviii., the case of a creole with a tumor in the neck is mentioned, which was submitted to the inspection of several celebrated surgeons in America, Paris, and London; all of whom pronounced it to be an aneurism of the carotid artery. It was afterwards ascertained by M. Boyer, that no such disease existed—but simply an extensive enlargement of the glands of the neck.

Derangement of the cerebral functions.—In twelve of the thirty-eight cases, serious symptoms were manifested in the brain after the ligature. The effect of cutting off the supply of blood through one of the carotids is so interesting, and until the researches of Mr. Chevers, of London,[1] was looked upon so lightly by practical surgeons, that we shall give these results somewhat in detail. In the first case in which the operation was ever done for the cure of aneurism, No. 1, paralysis of the left arm and leg came on on the eighth day. Four days afterwards, the palsy of the arm had almost disappeared, and no further report concerning it is made. In No. 4, there was great drowsiness on the third day, and, on the following day, the right side was much more feeble than the left. After some days these symptoms gradually disappeared. In No. 18, the patient became slightly convulsed on the right side, one and a half hours after the operation, and sunk into a state of stupor. Two days afterwards, his left side became paralyzed. In No. 16, it is stated, that "a few hours after the operation, symptoms of inflammation of the brain arose," but were subdued by the atiphlogistic treatment. In No. 37, apoplexy occurred on the morning of the day following the operation, from which the patient partially recovered, and lingered on for nine days after it. In No. 35, slight cerebral disturbance arose the day after the ligature, and on the fourth day there was paralysis of the left side. In No. 17, dimness of vision, and a sense of coldness over the right side of the face, came on immediately after the operation, which gradually disappeared in a few hours, though for some days, headache, difficulty of deglutition, and heaviness in the right side, were complained of. In No 20, the patient lost the use of the left eye, and was affected with hardness of hearing. In No. 25, there were slight convulsions on the second day after the operation. In No. 9, giddiness, with numbness and trembling of the right arm, came on two hours after the operation, the numbness disappeared the day after. In No. 34, hemiplegia followed (the side is not stated), which, it is added, may have occurred at the moment of tying the ligature, but was not remarked until an hour or more after the operation, and the patient continued faint and hemiplegic till her death on the fifth day. In No. 26, coma supervened on the night after the operation, and the patient soon after died. Of these twelve cases, seven died.

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[1] The paper of this gentleman will be found in the London Medical Gazette, vol. i., N. S., 1845.

These cerebral symptoms were noticed at various intervals after the tying of the artery, and in all of them, are attributable either to cutting off the direct supply of blood to the brain, or to disease consequent upon the altered condition of the circulation in that organ. It is impossible to determine what particular state of the vessels of the brain predisposes it to become diseased after obliteration of the carotid. The researches of Mr. Chevers lead him to think that in most instances the fatal mischief is consequent upon deficient arterial supply, but that in some cases it may arise from increased pressure of blood upon the arteries of the affected hemisphere, in consequence of the supply to the carotid being diverted through the vessels of the circle of Willis.

SERIES II.—WOUNDS, ETC.

Of the thirty cases contained in this series, fifteen were cured and fifteen died.

Period the ligature separated.—In thirteen cases in which this is noted the ligature came away: in one, before the tenth day; in nine, between the tenth and twentieth days, and in three, between the twentieth and thirtieth days.

Hemorrhage after the operation.—In six cases hemorrhage followed at various intervals after the application of the ligature, and of these three died.

Derangement of the cerebral functions.—In eight of the thirty cases in this series, serious cerebral symptoms occurred, either from inflammation or from interruption to its normal circulation, and of these eight only two recovered. In one of them, No. 16, the operation was followed by troubled vision, which remained imperfect on the right side. In No. 18, immediately after the application of the ligature, the patient became motionless, lay with closed eyes without answering when spoken to, unless the questions were repeated several times. This state was followed by coma and death in twenty-four hours. In No. 6, headache and delirium occurred on the fifth day after the operation, and on the seventh, stupor and death. In No. 14, it is stated that she lay for two or three days subsequent to the operation in a state of insensibility, and then gradually recovered. In No. 26, hemiplegia of the left side of the body and right side of the face was observed three hours after the operation, and the patient died on the ninth day. In No. 2, the man, on the night of the operation, became delirious and had convulsions which were most violent on the left side, and soon afterwards his right side became hemiplegic. In No. 22, hemiplegia of the left side came on on the sixth day. In No. 29, the patient during the operation made violent efforts with his right side, but never moved the left extremities. During the night the right extremities were frequently convulsed. In the two following days twitchings of the right side and paralysis of the left continued.

In No. 12, it is noted that the patient was epileptic, and that this condition was not removed by cutting off the supply of blood to the brain. In No. 19, the patient during the operation "became relaxed and seemingly faint, and his voice, which had been previously coarse, fell to a whisper and could not be raised above it." The respiration was not disturbed. The operator attributes the feebleness of the voice to "turning off the supply of blood to the larynx through the upper thyroid artery," though it would seem more probable that, in the necessary hurry of this operation, and the obscurity of parts from the flow of blood, the superior laryngeal nerve had been included in the ligature. In No. 9, the vessel was secured to arrest hemorrhage following the extraction of a tooth, styptics and the actual cautery having been first in vain tried, but the bleeding continued after the vessel was tied.

In No. 26, a mistake occurred in regard to tying the artery which merits notice. On the fifth day after the receipt of the wound in the side of the neck, the surgeon in attendance tied what was supposed to be the primitive carotid; compression, which had before been employed, was continued. Three days after hemorrhage returned as severely as ever, and M. Sédillot, who was then consulted, finding that the ligature had really not been placed around the artery, proceeded to secure it.

A most instructive case, in which an error similar to that just mentioned was made, occurred at the New York Hospital in 1840. The case was one of violent hemorrhage arising from ulcerations towards the middle of the neck, in which it was determined to apply a ligature to the common carotid. An incision was made in the ordinary manner on the inner side of the sterno-mastoid muscle, and in the usual situation of the sheath of the vessels a large mass of fibrine was found adhering to all the tissues in that region and confounding them in such a manner, that it was difficult to distinguish one from another. After careful dissection, what appeared to be the sheath of the vessel was exposed and divided. A cylindrical body of the size and color of the artery was then brought into view, and a ligature passed under it. Several of the surgeons present, as well as the operator, felt the vessel under which the ligature was placed and were convinced that it was the carotid artery, although no distinct pulsation could be felt in it; this was attributed to the extreme prostration to which the patient was reduced. The ligature was then tied without any effect in arresting the flow of blood. From this it seemed evident that the subclavian, or one of its branches, was wounded, but the patient was so prostrated that it was not deemed safe to attempt any further operation. Firm pressure with the hand was therefore continued. Death occurred early on the following day. Upon post-mortem examination, the ligature was found to embrace only a band of organized lymph, situated immediately anterior to the sheath of the vessels, which were in a perfectly healthy condition. The hemorrhage was found to proceed from the inferior thyroid, which was destroyed by ulceration in one-half of its circumference for the space of an inch.[1]

SERIES III.—ON EXTIRPATION OF TUMORS.

In this series, there are eighteen cases in which the common carotid was tied previous to, or at the time of the extirpation of tumors of the neck or jaw. Of these, six died, and one is stated to have been "recovering on the eighth day."

In one of these, the external jugular vein was wounded in exposing the artery (No. 16). In No. 15, where the artery of the right side was secured, the patient had, on the evening of the operation, "not exactly paralysis, but great difficulty in moving the left arm and leg." On the seventh day, "incipient coma, loss of sensation and motion in the left arm" is noted, and on the day after sensation and motion in the arm are said to have returned. No further account is furnished. In No. 10, the patient is stated to have been seized with convulsive action of the muscles of the whole body, but chiefly on the left side, on the morning after the operation, and on the succeeding day was suddenly taken with convulsions, soon became comatose, and died.

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[1] New York Medical Gazette, Feb. 9, 1842.

The ligaturing of the carotid, previous to the extirpation of tumors about the neck or face, originated with Mr. Goodlad. Unless there is reason to suppose that the tumor involves the artery itself, it would seem to be an unnecessary step, inasmuch as pressure alone, if confided to a careful assistant, will as effectually guard against the danger from hemorrhage. In determining whether or not it is to be employed, it must be borne in mind that this preliminary measure is in itself a *dangerous* operation, and as has been justly remarked by Mr. Chevers, that "it would be far better for the surgeon to make up his mind to contend with an active hemorrhage, than that he should submit his patient to the chance of fatal hemiplegia, even although he believed that chance to be a remote one." The idea seems still to be entertained by some, that after such a step, the subsequent dissection of the tumor is nearly bloodless. The opinion is an erroneous one, the anastomoses being so free in the enlarged state of vessels which usually exist in these cases, as at times to pour out blood profusely. In 1827, Mr. Lizars attempted to remove the superior maxilla for a medullary tumor of the antrum. He commenced by tying the common carotid artery of the affected side, but was prevented from completing the operation by hemorrhage, the patient having lost upwards of two pounds of blood in a few seconds. In a case which occurred to Dr. Mott where the carotid was tied immediately before a disarticulation of one-half of the jaw, the hemorrhage was exceedingly profuse, and some fifteen or twenty vessels required to be tied. Where the ligature is applied to the artery, any number of hours, or days, as has been done, before the removal of the tumor, the procedure cannot, we think, be justified. According to Mott and Stedman, another advantage besides that of arresting hemorrhage is to be derived from it, viz., that of being an important means of preventing inflammation in the wound. Facts might be adduced to show this view to be erroneous—the inflammation being no greater where the artery is not secured, than where it is tied.

The difficulties and immediate dangers of exposing the carotid vessel too, in cases of large tumors, are not to be set down lightly. Roux, as dexterous an operator as any of his age, was fifteen minutes in securing the artery. Goodlad found it a very difficult matter to accomplish, in consequence of the nearness of the tumor. In a case operated upon by Dr. Mott, notwithstanding the patient was recumbent, and very little blood was lost, she became pale and almost pulseless during and immediately after the tying of the carotid, and her mind became perturbed to so great a degree that cordials were administered and she was put to bed faint and exhausted, and the removal of the tumor deferred till the following day. In an operation, mentioned by Dr. Warren, of a similar kind, a vein was wounded in the search for the carotid, which permitted the entrance of air into the circulation, and gave rise to alarming symptoms, making it necessary to suspend the operation, which was performed a week afterwards *without* tying the vessel. As a preliminary step to the operations we are now considering, the general experience of surgeons of the present day is decidedly against the proceeding. Mr. Liston, whose success in the management of tumors of the mouth and jaws, face and neck, is well known to every surgeon, speaks on this point very emphatically. "I have never," says he, "found occasion to tie the carotid previous to, or during the operations for their removal, and I have never regretted omitting this supposed precautionary measure." A writer upon this subject, Mr. Solly, gives it as his opinion, that if a ligature on the carotid is of advantage in any cases it is only where the tumor is of large size, and of a fungoid character, "in fact, that it is only necessary in those cases in which it is not right to operate at all."

SERIES IV.—CEREBRAL AFFECTIONS.

The idea of curing epilepsy by tying the carotid artery seems to have been founded upon the false principle, that this operation would diminish the amount of blood sent to the head, a view, however, which is manifestly incorrect, for though the supply sent to the brain by one of these vessels should be cut off, it passes in increased amount by the artery of the opposite side and the vertebrals. But the notion that epilepsy is essentially dependent on vascular excitement, it need hardly now be said, is in itself an erroneous one. Any irritation, in any part of the body, and either corporeal or mental, may give rise to it. Vascular excitement may doubtless occasionally be its exciting cause, though even where this is the case any benefit resulting from obstructing the flow of blood through the carotid is not likely, for the reason before mentioned, to prove permanent. As early as 1822, ligature of the carotid was done in an epileptic patient with wounded throat, by Dr. Boileau, and for a considerable time he remained without an attack, though ultimately a recurrence of them had taken place. In Dr. Becton's Case, No. 2 of the table, the patient experienced two fits during the first ten days that elapsed after the operation, but after this he returned to his former intemperate habits and had frequent attacks. No. 4, who was operated upon in February, 1831, is stated by Mr. Preston to have continued well and free from epileptic attacks up to January, 1833. In No. 5, where hemiplegia of the right side of twenty days' standing existed with the epilepsy, the right carotid was tied August 23, 1831, and he was discharged from the hospital September 26th, having had several epileptic attacks, though of a milder kind than before the operation. In November he was readmitted, having suffered much from epilepsy and headache after his discharge. On the fourteenth of that month, the *left* common carotid was tied, and he was discharged December 8th, his epileptic attaks continuing. On the 14th of February, 1832, he was again readmitted in a state of insensibility, and had been speechless for fourteen days. Under the use of purgatives, a seton, leeches, etc., these symptoms gradually disappeared, and in January, 1833, was still living, though three months before that date he had suffered from an attack of paralysis agitans. In an appendix to his second paper, Mr. Preston states, that in one case of epilepsy this operation "proved entirely ineffectual." The patient had suffered from the disease for eight years. *Both* common carotids were tied with an interval of a month, and the day following each operation he had an epileptic fit not differing from those he had previously.

In one of the other three cases of this series (No. 1), the artery was tied for the cure of a neuralgic affection, the operator being led to perform it from noticing that pressure, which was accidently made on the artery, gave some relief; the benefit derived from it was only momentary. In Nos. 3 and 6, it was done with a view of curing paralysis. In the first of these, there was loss of power and sensation in the left arm and left lower extremity, and at the period of his discharge from the hospital (twenty-first day after the operation), the patient was able to walk about, the arm remaining paralytic. In January, 1833, he continued alive, and had regained in great part the use of his arm. In the second, No. 6, partial loss of motion existed in the left arm and leg, the patient being unable to walk without support. There was also complete loss of vision in the right eye, and that of the left was impaired. The operation was done on the right side on the 2d of September, and on the 27th, it is stated that he walked five miles, the morning after which, the sight of the left eye was less perfect and his head hot. He was slightly salivated, blistered between the shoulders, and took iodine, but without benefit. The diminution of the vision being now attributed to a return of the affection of the brain, for which the first operation had been done, the *left* common carotid was tied on the 10th of October. On the 11th of November he was dischared from the hospital, the vision remaining imperfect, though in other respects he was well.

The results of these cases we have thought it right, as matter of history, to give somewhat in detail. It need hardly be observed that quite as much, if not more, benefit as was produced in these cases, is daily seen to follow any well-directed treatment in cases of epilepsy and paralysis, and this without a resort to means which endanger life, indeed by hygienic treatment alone.

SERIES V.—ERECTILE TUMORS.—TUMORS OF DIPLOE, JAW, MAXILLARY SINUS, AND NECK.

In this table there are forty-two cases in which the carotid has been tied with the view of arresting the flow of blood to the tumor, and thus curing or arresting the growth of erectile tumors situated upon the head or face, or of firm tumors of the jaw, maxillary sinus, or neck. Of these forty-two cases, thirty-one were for the cure of erectile tumors, or arterial varices seated upon the head or face, of which number eighteen were cured, eight died, and five recovered from the effects of the operation without being cured. One of these latter, No. 27, was operated upon by the ancient method five years after ligature of the carotid, and cured; another, No. 24, is stated at the date of the report, two months after the operation, to have the tumor flattened and reduced to one-third of its former volume; in a third, No. 4, all pulsation in the arteries ceased, though the erectile tissue continued unchanged, and pressure was resorted to in its after-treatment; in the fourth, No. 42, galvano-puncture was tried after the ligature of the vessel, but without benefit; and the fifth is the case of Velpeau, which is detailed in another place.

Of the eleven cases in which it was done to cure or arrest the growth of other tumors, five died, four recovered from it but were not cured, and two are stated to have been cured, though in one of them, No. 5, part of the tumor was removed by the knife after the operation, and caustics ultimately were made use of to destroy it.

The treatment of purely erectile tumors by cutting off the supply of blood to them, by the application of a ligature to the main artery, originated with Pelletan, and has often, as will be seen by the above results, proved successful in the carotid—more frequently, we may add, than in other situations. In some instances, though it has failed to make a perfect cure, yet it seems to have so diminished or retarded the progress of the disease, as to have allowed a resort to excision, the ligature, or pressure, which without it, would have been either more dangerous or altogether inapplicable.

The facts recorded show that ligature of the carotid to diminish *non-erectile* growths of the face, jaws, or neck has proved altogether ineffectual where it has been alone depended upon, and cannot at this day be countenanced by sound surgery.

A summary of the whole number of cases contained in this series furnishes the following results:—

Mortality.—Of the forty-two cases, twenty were cured, thirteen died, and nine recovered from the operation, though not cured by it.

Right or left side.—In thirty-nine of the cases in which the side is noted, nineteen were on the right side and twenty on the left.

Age.—This is given in thirty-four of the cases, of which number there were under 20, sixteen; between 20 and 30, eleven; 30 and 40, four; 40 and 50, two; æt. 66, one.

Period the ligature separated.—In twenty-three of these cases in which it is noted the ligature separated; in three, before the tenth day; in eleven, between the tenth and twentieth days; in six, between the twentieth and thirtieth days; and in three, above the thirtieth day.

Return of pulsation in the tumor after the application of the ligature.—In ten of the cases of erectile tumors, more or less thrill of pulsation was noticed in the tumors after the application of the ligature. In six of these cases, the disease was situated in the orbit, and in the other four, on the face or head. The case of M. Velpeau (No. 35) is so rare and interesting a one, that I annex some of the details of it. The patient was affected with tumors in both orbits, offering all the signs characteristic of erectile tissue, and that on the right side was large and projecting. Compression of the right primitive carotid arrested completely the pulsation and thrill in the tumor of the left orbit, and incompletely in that of the right, while pressure on the left carotid put a stop completely to all pulsation in the tumor of the right orbit, and but incompletely in that of the left. After the right artery was ligatured the tumor of the left side ceased to pulsate; the tumor of the right side shrunk, but pulsation could still be perceived in it. At the end of ten days, all pulsation had ceased, and the patient appeared to be cured. He remained, however, in the hospital for six weeks, and during this interval it became evident that the cure was not perfect, pulsation having reappeared by degrees in the tumor of the right side. In February, 1840 (about six months after the operation), he remained in nearly the same state as he was six weeks after it, and at that date, compression of the carotid of the left side arrested both the pulsation and thrill in the tumor of the right orbit. Ligature of the last-named artery was at this period proposed, but was refused by the patient.

Hemorrhage after the operation.—This occurred in six cases, four of which terminated fatally. In No. 6, bleeding from the wound in the neck took place on the twenty-third day, was repeated several times, and ceased spontaneously; in No. 2, hemorrhage from the lower part of the wound occurred and also ceased spontaneously.

Cause of death.—Of the forty-two cases in this series, thirteen died. Of these, one died from ulceration of the tumor; four from hemorrhage; one, from convulsions; one, from inflammation of the brain; one, from phlebitis of the internal jugular; one, from lock-jaw; one, from inflammation of the chest; two, from long-continued constitutional disturbance occasioned by disease; and one from apoplexy.

Derangement of the cerebral functions.—In eight of the forty-two cases, very serious symptoms of affection of the brain were manifested after the ligature of the vessel. In No. 4, a sense of numbness in the left thoracic member came on the evening of the operation which disappeared on the second day. In No. 10, some fever with delirium and paralysis of the left side of the face and hand appeared on the third day.[1] In No. 17, convulsions and paralysis of the right arm came on on the sixth day, after recovery from which, at the end of three months, her intellect remained enfeebled; the disease for which the operation was done being but little changed.

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[1] In this case it is noted that the internal jugular vein was included in the ligature.

In No. 18, vision of the left eye became seriously affected on the eleventh day after the operation, and the patient had some degree of deafness and delirium; on the eighteenth day the eyeball was protruded and sloughed. In No. 26, complete hemiplegia followed the operation.[1] In No. 30, the woman had paralysis of the left side on the second day after the operation. In No. 32, aged fifteen months, the child was attacked suddenly with convulsions and hemiplegia of the right side about a week before the complete healing of the wound and forty-nine days subsequent to the operation. In No. 38, paralysis of the left side came on the day after the vessel was tied.[2]

SERIES VI.—BRASDOR'S OPERATION.

Upon fifteen cases of aneurisms of the lower part of the neck, in which the carotid has been ligatured between the aneurismal tumors and the capillaries, four appear to have been cured (Nos. 1, 4, 5, and 12); six recovered from the operation and appear to have had some relief of symptoms after it; four died; and in one, in which the artery probably was not really tied, there was no improvement. Nine of these fifteen operations were done for aneurisms, or cases supposed to be such, of the arteria innominata; of which, five recovered and four died.

Derangement of the cerebral functions.—In two of these fifteen cases derangement of the cerebral functions followed the ligature of the carotid. In No. 5, where the right artery was tied, the face and whole right side of the body were partially paralyzed, which paralysis was only discovered when the patient first left his bed, three weeks after the operation. In No. 15, where the right carotid also was tied, the patient complained immediately on tightening the ligature of severe pain in the side of the head; the pupil of the opposite eye became slightly dilated, he felt bewildered and confused, and could with difficulty be induced to remain quiet. On the day of his death, the left pupil was largely dilated. He was sensible to the last.[1]

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[1] The internal carotid was tied in this case as well as the common trunk.

[2] Another case is quoted without details in the *Gazette Médicale* for 1839, from *Rust's Magazin*, where the common carotid was tied by Dohlhoff to arrest the growth of a tumor of the palate; paralysis of the side opposite to that in which the operation was practised took place a week after it, and was followed by death on the twenty-sixth day.

Difficulties of diagnosis.—It is not intended in this place to dwell upon the difficulty of diagnosis which must often exist in aneurisms about the root of the neck. We shall here only notice that in three of the cases in our table where the root of the carotid or the innominata was supposed to be the seat of the tumor, it was found actually to have arisen from the aorta itself. Velpeau, in his *Médecine Opératoire*, mentions two other cases in which the carotid was tied where similar mistakes in diagnosis occurred. One of these was observed in the civil hospital of Amsterdam, in a man affected with an aneurismal tumor projecting above the sternum. M. Tillanus believing the left carotid to be the seat of the disease, tied that vessel a little beyond the tumor. The patient recovered from the operation, but died suddenly five months afterwards, when the tumor was seen to arise from the arch of the aorta and to be completely filled with a white clot. The parts are shown in the pathological collection of the hospital. In the other case, the aneurism, which appeared to be on the point of bursting, showed itself as the preceding one just above the sternum. Looking upon it as an aneurism of the carotid, M. Rigen placed a ligature above the tumor on the 21st of February, 1829. After the operation the tumor diminished considerably in size, and the sufferings of the patient became less. On the 13th of June following, he died with symptoms of asthma. The autopsy showed the aneurism to have its origin in the arch of the aorta between the left carotid and the innominata, and was filled up, as in the case of Tillanus, by coagùla.

LIGATURE TO BOTH CAROTIDS.— In a few instances, the carotids of both sides have been ligatured either simultaneously, or with varying intervals of time between the operations. Two such cases have already been noticed where the procedure was followed by Mr. Preston, and we shall here mention the other recorded cases in which it has been done. About the year 1823, Dr. Macgill, of Maryland, tied both carotids in the case of a female affected with fungous tumors of both orbits. Vision was destroyed, and the eyes presented the appearance of a confused mass protruding beyond the sockets. Several months after the operation, she is said to have been doing well, and the tumors subsiding. In a case of aneurism by anastomosis of the scalp, Dr. Mussey tied the left primitive carotid, September 20th, 1827, and on the twelfth day after, secured that of the right side. These operations failed to cure the disease, though they had the effect of reducing the tumor apparently to about one-third of its original volume. It was subsequently, in consequence of its again enlarging and exhibiting a pulsatory movement, removed by excision about three weeks after the second operation. In this operation, which occupied more than an hour, notwithstanding that not more than an inch and a half of the scalp was divided at a time, and that immediately upon the division, firm compression was made upon each lip of the incision, while the vessels were secured by ligature, yet blood to the amount of nearly two quarts was lost, and the application of more than forty ligatures was required. The patient did well, and ten years after continued to enjoy good health, though, occasionally, he had symptoms of cerebral plethora. Langenbeck, in a case of profuse hemorrhage, coming on eight days after the application of a ligature to the superior thyroid for the cure of bronchocele, ligatured both carotids. The patient died on the following day. In a child four and a half years of age, Muller tied one primitive carotid, September 13th, 1831, for the cure of an erectile tumor, and on the 28th of January, 1832, secured the other. The operation was successful. Kuhl, of Leipsic, in the case of a man aged 53, affected with an aneurismal tumor on the occiput, tied the left carotid on the 24th of May, 1834, and on the seventy-second day after, in consequence of profuse hemorrhage from the scalp, took up that of the right side. The patient was cured, though he had after-hemorrhages from the tumor which suppurated. During the first of these operations, the patient was seized with convulsions and faintings, and was removed to his bed in a state of insensibility; slight convulsions also occurred during the performance of the second operation. Dr. Mott ligatured both carotids, with an interval of fifteen minutes, for disease of the parotid. Coma supervened, and the patient survived only a few hours. Dr. Ellis, of Michigan, in 1844, tied both of these vessels, with an interval of four and a half days, in a case of secondary hemorrhage, following a gunshot wound, and cured his patient. Dr. J. M. Warren, in a case of erectile tumor affecting the mouth, face, and neck, tied the left primitive carotid, October 5th, 1845, and on the 7th of November following, ligatured that of the right side. After this second operation, the tumor of the lip diminished one-half, and the fulness of the face and neck and size of the tongue became less. Finding that the disease did not wholly disappear, it was determined, on the 26th of November, to remove the diseased portion of the lower lip, "not less than two inches in length, at its free edge," by a triangular incision; but previously to this, in order to avoid hemorrhage, a cataract-needle was plunged into the vascular tissue on the left side, and carried in different directions so as to break up and destroy its organization. Three days afterwards, a similar operation was repeated on the right side, and at the time the excision was made, strong compression was exercised on each side of the lip by means of two steel forceps prepared for the purpose, so as completely to intercept the course of blood into it. On the 12th of December the patient returned home well.

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[1] The *Gazette Médicale* for 1839 mentions that in an operation by the method of Brasdor, done for the cure of an aneurism of the innominata by Dohlhoff, death followed in a few days, and was preceded by symptoms of paralysis of the side opposite to that on which the artery was tied.

ARTERIA INNOMINATA.—The practicability of securing this vessel was suggested by Mr. Burns, in his Anatomy of the Head and Neck, though, as he acknowledges, "without any sanguine expectations of success." It was first put in practice by Dr. Mott, in 1818, in a patient affected with subclavian aneurism, aged 57. The ligature, which was applied about half an inch below the bifurcation of the innominata, separated on the fourteenth day. On the twenty-third day, he had hemorrhage to such an extent, as to threaten instant death; this was arrested for the time by dry lint and a compress, but after several recurrences of it he died on the twenty-sixth day.[1] In 1822, Graefe tied the artery in a similar case. The ligature was applied about an inch above the arch of the aorta, and came away on the fourteenth day. After repeated bleedings, the patient died on the sixty-seventh day. Dr. Hall, of Baltimore, performed the operation, for a third time, in 1830. In attempting to isolate the artery, which was in a diseased condition, its coats gave way, and a profuse hemorrhage occurred. An attempt was then made to pass the ligature by means of a needle, but the bleeding continuing, the wound was plugged up, and the patient put to bed. The patient survived until the fifth day.[2] Dupuytren states that a fourth operation was done at Paris, and that the patient also died of hemorrhage.[3] A fifth operation was accomplished by Mr. Norman, of Bath, in 1824, and was followed by death.[4] In 1837, Mr. Bland operated on a sixth case, in a patient aged 31. On the seventeenth and eighteenth days hemorrhage occurred, and on the evening of the latter day he died. The ligature was found to have encircled the artery close to its division into subclavian and carotid.[5] A seventh operation of this kind, was by Mr. Lizars, in 1837. The ligature came away on the seventeenth day. Several hemorrhages occurred after the nineteenth day, and death followed on the twenty-first day. Twenty ounces of coagulated blood were found on the right side of the chest.[6] An eighth instance of the same operation is given by M. Hutin. In this case, it was done to restrain hemorrhage from the axilla, nine days after deligation of the subclavian outside of the scaleni, which was ineffectual —twelve hours after its performance the patient died.[7] A ninth instance is mentioned by Chelius, which was operated upon by Arendt, where death, as in all the previous cases, closed the scene on the eighth day.[8]

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[1] Med. and Surg. Register, vol. i.

[2] Baltimore Med. and Surg. Journ., vol. i.

[3] Leçons Orales, tom. iv. p. 611.

[4] Fergusson's Surgery, p. 429, Philadelphia, 1845.

[5] Lancet, 1837.

[6] Lancet, 1837.

[7] Gazette Médicale, 1842.

[8] System of Surgery, Trans. by South.

The uniform want of success that has followed the application of a ligature to the arteria innominata, shows that the impetus of the blood has a great share in disturbing the process set up by nature after the ligature; to avoid this, Mr. Quain has proposed a modification of the operation, viz., the securing of the carotid and subclavian arteries, immediately as they arise from the innominata, it being supposed that by this means, the greater length of the artery from the arch of the aorta to the point of ligature would allow of a firmer coagulum to form. This modification was put in practice by Mr. Liston in 1838, in a case of subclavian aneurism, situated immediately beyond the scalenus muscle. On the eleventh day after the operation hemorrhage took place, and the patient expired on the thirteenth day. On dissection, it was found that a clot had formed in the innominata, but none in the subclavian.[1] Another case in which both vessels were included in one ligature, just at their origin, occurred to M. Kuhl, of Leipsic, in 1836. The patient aged 43, was affected with a cancerous tumor in the neck, and the surgeon, at the time of the operation, believed that he had tied the carotid alone. Death followed on the third day. Upon dissection, the right carotid and subclavian arteries were found tied together at three lines above their origin from the innominata, and their canals were in part obstructed.[2]

It may, perhaps, be well here to remark, that three cases are recorded, in which operations for securing the innominata have been actually begun and finally abandoned. Mr. Porter, in a case of aneurism, cut down upon this vessel, with a view of securing it, but finding it to be in such a condition as not to be advisable for a ligature, he prudently closed the wound.[3]

Dr. A. C. Post has given a somewhat similar case which occurred at the New York Hospital. The patient, aged 63, was affected with subclavian aneurism, and an explorative operation was performed "to determine the condition of the subclavian and innominata, with the intention, if the arteries should be healthy, to apply a ligature to the subclavian and carotid near their origin." The innominata, carotid, and subclavian were exposed, but the former was so much enlarged that it was deemed inexpedient to apply a ligature to it or to its branches, so that the wound was closed, and the patient sent back to his bed. This was done October 26, 1839, and he died exhausted by his sufferings, January 19, 1840.[1] The third case of this kind is that of Mr. Key, who commenced an operation upon a young woman affected with aneurism of the right subclavian, with the view either of passing a ligature around the innominata, or of tying both the subclavian and carotid near their common origin, as the state of the parts when disclosed by the knife might render most advisable. After exposing the arteria innominata, it was found impossible to surround that vessel, in consequence of a tumor connected with it, and the operation, which had lasted one hour, was abandoned. The patient died on the twenty-third day after it.

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[1] Lancet, 1838.

[2] Velpeau, Méd. Opératoire, tom. ii.

[3] Fergusson's Surgery, p. 430.

Should the unfortunate results of all these cases prevent a resort to the operation of deligation of the brachio-cephalic trunk in future? We think but one answer can be returned to this query; and are happy to find that the author of the most celebrated of our modern treatises on Operative Surgery, Velpeau, has already formally proscribed it.

MORTALITY FOLLOWING THE OPERATION OF TYING THE FEMORAL ARTERY.

The following tables show strikingly the dangers attendant upon the Hunterian operation, for what appears to be the most common form of external aneurism; and, inasmuch as it is that to which the treatment by compression is more particularly adapted, I have added to it a tabular statement of the cases treated by the latter method, taken from Mr. Bellingham, together with such others as have come to my knowledge since the issue of his valuable little work from the press.

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[1] New York Journal of Medicine, No. 4.

No.	Surgeon	Sex.	Age.	Right or left side.	Disease or injury.	Duration of disease.	Ligature separated.
1	J. Hunter	M.	45	....	Popliteal aneurism	3 years	Some on 15th day
2	J. Hunter	M.	40	....	Popliteal aneurism	....	14th day
3	J. Hunter	M.	35	....	Popliteal aneurism	....	14th day
4	J. Hunter	M.	36	....	Popliteal aneurism	....	29th day
5	J. Hunter	M.	42	Left side	Popliteal aneurism	....	11th day
6	Lynn	M.	25	....	Popliteal aneurism	....	13th day
7	Birch	M.	43	Right side	Femoral aneurism	....	....
8	Cline	M.	...	....	Popliteal aneurism	....	Removed 9th day
9	Kast	M.	16	....	Femoral aneurism from wound	3 days	....
10	Forster	M.	35	....	Popliteal aneurism	....	17th day
11	Earle	M.	50	Left side	Popliteal aneurism	....	15th day
12	Chopart	...	...	Left side	Popliteal aneurism	....	....
13	Deschamps	M.	34	Left side	Popliteal aneurism	6 months	30th & 31st days[1]
14	Deschamps	M.	42	Left side	Popliteal aneurism	....	....
15	Forster	M.	37	Left side	Popliteal aneurism	14 months	22d day
16	Deschamps	M.	32	Left side	Popliteal aneurism	....	....
17	Forster	M.	37	Right side	Femoral aneurism	9 months	10th day
18	Home	M.	36	....	Popliteal aneurism	....	12th day
19	Pelletan	M.	60	....	Popliteal aneurism	15 days	....
20	Harris	M.	32	Right side	Popliteal aneurism	....	11th day
21	Scarpa	M.	33	Right side	Popliteal aneurism	....	16th day
22	Home	M.	33	Right side	Popliteal aneurism	6 weeks	....
23	Home	M.	33	Left side	Popliteal aneurism	....	16th day
24	Knight	M.	35	Left side	Popliteal aneurism	....	30th day
25	Home	M.	50	....	Popliteal aneurism	....	....
26	Pelletan	F.	28	Right side	Popliteal aneurism	....	....
27	Scarpa	M.	46	Left side	Popliteal aneurism	9 years	18th day
28	Scarpa	M.	42	Right side	Popliteal aneurism	6 months	18th day
29	Pelletan	M.	70	Right side	Popliteal aneurism	....	Removed 25th & 26th days
30	Pelletan	F.	34	....	Popliteal aneurism	....	Removed on 22d day
31	A. Cooper	M.	27	....	Popliteal aneurism	5 months	24th day
32	A. Cooper	M.	29	Right side	Popliteal aneurism	4 months	14th & 15th days[1]
33	Scarpa	M.	34	Left side	Femoral aneurism	25 months	14th day
34	Scarpa	M.	46	Right side	Popliteal aneurism	5 months	21st day

[1] Double ligature.

Date of operation.	Result.	Period of death.	Cause of death.	Work.
December, 1785	Cured	....	....	Trans. of a Soc. for Improvement of Med. and Chir. Knowledge, vol. i.
....	Died	26th day	Hemorrhage	do do vol. i.
....	Cured	....	....	do do vol. i.
....	Cured	....	....	do do vol. i.
....	Cured	....	....	do do vol. i.
....	Cured	....	....	do do vol. i.
Nov. 3d, 1786	Died	11th day	Hemorrhage	do do vol. i.
....	Died	....	Attacked by fever, of which he died	do do vol. i.
May 28th, 1786	Cured	....	....	Massachusetts Medical Comm., 1790, vol. i.
Aug. 22d, 1791	Cured	....	....	Medical Facts and Observations, vol. v.
Jan. 28th, 1792	Cured	....	....	Trans. of a Soc. for Improvement of Med. and Chir. Knowledge, vol. i.
March 28th, 1792	Died	....	Gangrene of limb	Obs. on Aneurism. Sydenham Society, 1844.
April 7th, 1792	Cured	....	....	do do do
June 19th, 1793	Died	In a few days	Purulent absorption	do do do
June 24th, 1793	Cured	....	....	Med. Facts & Obs., vol. v.
Sept. 9th, 1793	Cured	....	....	Obs. on Aneurism. Sydenham Society, 1844.
August 11th, 1794	Cured	....	....	Med. Facts & Obs., vol. vi.
1794	Cured	....	....	Trans. of a Soc. for Improvement of Med. and Chir. Knowledge, vol. ii.
April, 1795	Died	7th day	Gangrene of limb	Clin. Chirurgicale, tom i.
Nov. 15th, 1795	Cured	....	....	Trans. of a Soc. for Improvement of Med. and Chir. Knowledge, vol. ii.
March 28th, 1796	Cured	....	....	On Aneurism. Edin. 1808.
June 9th, 1797	Cured	....	....	Trans. of a Soc. for Improvement of Med. and Chir. Knowledge, vol. ii.
July 14th, 1797	Cured	....	....	do do vol ii.
Sept. 29th, 1797	Cured	....	....	do do vol. ii.
May 22d, 1798	Died	12th day	Hemorrhage	do do vol. ii.
1798	Died	5 months after	Hectic & diarrhœa	Clin. Chirurgicale, tom. i.
April 28th, 1799	Died	37th day	Mortification of sac	On Aneurism.
Feb. 25th, 1800	Cured	....	....	do do
Feb. 1801	Died	43d day	Hemorrhage	Clin. Chirurgicale, tom. i.
Dec. 31st, 1801	Cured	....	....	do do tom. i.
April 13th, 1802	Cured	....	....	London Med. and Phys. Journ., vol. viii.
May 3d, 1802	Cured	....	....	do do vol. viii.
March 3d, 1803	Cured	....	....	On Aneurism.
Feb. 25th, 1804	Cured	....	....	do do

No.	Surgeon.	Sex.	Age	Right or left side.	Disease or injury.	Duration of disease.	Ligature separated.
35	Mursinna	M.	54	....	Popliteal aneurism	7 months	....
36	Blizard	M.	45	....	Popliteal aneurism	6 months	....
37	Simpson	M.	28	Right side	Popliteal aneurism	2 months	....
38	At Deal Hospital	M.	...	....	Popliteal aneurism	2 months	12th & 14th days[1]
39	Andrews	...	...	Right side	Popliteal aneurism	2 months	12th & 13th days[1]
40	Dawson	M.	54	....	Popliteal aneurism	7 months	23d day
41	Hosack	M.	30	Right side	Femoral aneurism	2 months	13th day
42	Dupuytren	F.	62	....	Ruptured artery with fractured leg	....	15th day
43	Hutchison	M.	48	....	Femoral aneurism	5 years	14th day[1]
44	Ramsden	M.	32	Right side	Femoral aneurism	9 months	14th day
45	Ramsden	M.	...	Right side	Popliteal aneurism	3 weeks	8th day
46	Ramsden	M.	34	Left side	Femoral aneurism	15 weeks	14th & 15th days
47	Hutchison	M.	32	....	Popliteal aneurism	3 months	21st day
48	Kirby	M.	33	Left side	Popliteal aneurism	....	15th day
49	Hosack	M.	...	Right side	Femoral aneurism from wound	2 months	13th day
50	Onderdonk	M.	40	....	Popliteal aneurism	1 month	22d & 23d days[1]
51	Onderdonk	...	...	....	Wounded knee joint	....	18th day[1]
52	Mackesy	M.	38	Right side	Femoral aneurism	1 year	....
53	Lawrence	M.	...	....	Popliteal aneurism	1 year	18th day
54	Dickinson	...	...	Right side	Popliteal aneurism	....	....
55	Dease	M.	26	....	Popliteal aneurism	6 months	In 24 hours removed
56	Travers	...	...	....	Aneurism of posterior tibial	....	5th day
57	Crampton	M.	39	....	Popliteal aneurism	4 weeks	On 3d day removed
58	Browne	M.	25	....	Popliteal aneurism from wound from necrosed femur	8 days	....
59	Browne	M.	27	....	Aneurism of posterior tibial	2 months	9th & 11th days[1]
60	Norman	M.	36	Right side	Popliteal aneurism	1 week	15th day
61	Norman	M.	37	Left side	Popliteal aneurism	2 weeks	....
62	Kirby	M.	23	Left side	Femoral aneurism	....	21st day
63	Norman	M.	38	Right side	Popliteal aneurism	3 days	....
64	Physick	M.	...	....	Varicose aneurism below the knee	12 years	....
65	Roberts	M.	32	....	Popliteal aneurism	....	In 24 hours removed
66	Dupuytren	M.	...	....	Diffused aneurism upper part of leg from gunshot	1 month	20th day
67	Monteath	M.	...	....	Popliteal aneurism	....	30th day

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[1] Double ligature.

Date of operation.	Result.	Period of death.	Cause of death.	Work.
April 1st, 1804	Died	33d day	Gangrene of limb	On Anuerism.
July 24th, 1804	Died after amputation	....	Gangrene of limb	do do
Nov. 23d, 1804	Cured	....	....	London Med. and Phys. Journ., vol. ii., N. S.
March 18th, 1805	Died	27th day	Hemorrhage	do do vol xvii.
Oct. 19th, 1805	Cured	....	....	do do vol. xvii.
May 11th, 1807	Cured	....	....	Edinburgh Med. & Surg. Journ., vol. iii.
March 31st, 1808	Cured	....	....	Amer. Med. & Phil. Reg., vol. iii.
Jan. 3d, 1809	Cured	....	....	Leçons Orales, tom. iv.
July 5th, 1810	Cured	....	....	Cases, p. 9.
Sept. 24th, 1810	Cured	....	....	Practical Observations.
....	Cured	....	....	do do do
....	Cured	....	....	do do do
Feb. 19th, 1811	Cured	....	....	Cases.
Feb. 8th, 1813	Cured	....	....	do
March 1st, 1813	Cured	....	....	Amer. Med. & Phil. Reg., vol. iii.
May 15th, 1813	Cured	....	....	do do vol. iv.
June 17th, 1813	Cured	....	....	do do vol. iv.
Oct. 8th, 1813	Cured	....	....	Edinburgh Med. & Surg. Journ., vol. xi.
October, 1813	Cured	....	....	Med. Chirurg. Transacts., vol. vi.
....	Died	23d day	Tetanus	Lond Med. Repos., vol. i.
Feb. 27th, 1815	Cured	....	....	Med. Chir. Trans., vol. vii.
Feb. 23d, 1816	Died	7th day	Hemorrhage	do do vol. vii.
October 14th	Cured	....	....	do do vol. vii.
Sept. 1st, 1817	Died	....	Gangrene of limb	Dub. Med. Jour., vol. viii.
Sept. 1st, 1817	Died	41st day	Thoracic inflammation and abscess in the course of the artery	Medico-Chirurgical Rev., vol. xxiv.
Oct. 6th, 1817	Cured	....	....	Med. Chir. Trans., vol. x.
June 6th, 1818	Cured	....	....	do do vol. x.
Feb. 20th, 1818	Cured	....	....	Cases.
March 7th, 1818	Cured	....	....	Med. Chir. Trans., vol. x.
....	Died	....	Gangrene of limb and hemorrhage	Dorsey's Elements, vol. ii.
June 6th, 1818	Cured	....	....	Med. Chir. Trans., vol. xi.
1818	Cured	....	....	Leçons Orales, tom. iv.
Feb. 27th, 1819	Cured	....	....	Cooper's Surg. Dictionary, 1838

No.	Surgeon.	Sex.	Age.	Right or left side.	Disease or injury.	Duration of disease.	Ligature separated.
68	Dupuytren	M.	39	Right side	Pulsating tumor of head of tibia	....	15th day
69	Janson	M.	49	....	Popliteal aneurism	....	11th day
70	Adam	M.	30	Left side	Popliteal aneurism	2 months	19th & 21st days[1]
71	Liston	M.	35	Right side	Popliteal aneurism	3 weeks	22d day
72	Liston	M.	30	Left side	Popliteal aneurism	12 months	17th day
73	Carmichael	M.	40	Right side	Popliteal aneurism	....	....
74	At Meath Hospital	M.	...	....	Popliteal aneurism	....	....
75	Todd	M.	30	Right side	Popliteal aneurism	4 months	18th & 19th days[1]
76	Todd	M.	27	Left side	Popliteal aneurism	2 months	18th day
77	Perry	M.	45	Right side	Femoral aneurism	1 month	....
78	Gunning	M.	47	....	Popliteal aneurism	6 weeks	17th day
79	Travers	M.	25	Left side	Popliteal aneurism	7 weeks	19th day
80	Travers	M.	25	Right side	Popliteal aneurism	....	13th day
81	Travers	M.	31	....	Popliteal aneurism	2 weeks	18th day
82	Liston	M.	35	....	Femoral aneurism	....	....
83	A. Cooper	M.	47	Left side	Popliteal aneurism	....	42d day
84	Travers	M.	32	....	Popliteal aneurism	....	....
85	Liston	M.	43	....	Popliteal aneurism	2 months	....
86	D. L. Rogers	M.	30	....	Wound of knee-joint	....	15th day[1]
87	Stephenson	F.	90	Left side	Popliteal aneurism	2 months	18th day
88	Mott	M.	34	....	Compound dislocation of ankle	....	....
89	Key	M.	30	Left side	Popliteal aneurism	6 weeks	....
90	Uccelli	M.	...	....	Popliteal aneurism	....	....
91	Travers	M.	37	....	Femoro-popliteal aneurism	....	....
92	Benja	M.	50	Left side	Popliteal aneurism	6 months	24th day[1]
93	Arnott	M.	34	Left side	Popliteal aneurism	4 months	31st day
94	Dupuytren	M.	22	....	Varicose aneurism of thigh	6 months	....
95	C. Bell	M.	45	Left side	Popliteal aneurism	4 years	....
96	Baynham	M.	20	....	Varicose aneurism of thigh and aneurismal varix near the ankle	3 years	11th day
97	McFarlane	M.	45	Left side	Popliteal aneurism	7 months	12th day
98	McFarlane	M.	45	Right side	Popliteal aneurism	....	....
99	McFarlane	M.	36	Left side	Popliteal aneurism	3 weeks	19th day
100	McFarlane	M.	42	Left side	Popliteal aneurism	5 weeks	26th day
101	Wright	M.	38	Right side	Popliteal aneurism	1 year	45th day
102	McFarlane	M.	38	Right side	Aneurism of anterior tibial and popliteal	....	....

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[1] Double ligature.

Date of operation.	Result.	Period of death.	Cause of death.	Work.
March 16th, 1819	Cured	....	....	Répertoire d'Anat., tom. ii.
July, 1818	Cured	....	....	Mélanges de Chirurgie.
April 3d, 1819	Cured	....	....	Edinburgh Med. & Surg. Journ., vol. xviii.
Oct. 1st, 1819	Cured	....	....	do do vol. xvi.
Oct. 5th, 1819	Cured	....	....	do do vol. xvi.
May 25th, 1818	Died	19th day	Phlebitis	Transacts. Coll. of Phys. of Ireland, vol. ii.
1819	Died	....	Hemorrhage	do do vol. ii.
Sept. 1st, 1820	Cured	....	....	Dub. Hosp. Reps., vol. iii.
Sept. 1st, 1820	Cured	....	....	do do vol. iii.
Jan. 20th, 1821	Cured	....	....	Glasgow Medical Journal, vol. iv.
April 27th, 1821	Cured	....	....	Guthrie's Diseases of Arteries, 1830.
Nov. 22d, 1822	Cured	....	....	London Med. and Phys. Journ., vol. iii., N. S.
April 11th, 1823	Cured	....	....	do do vol. iii., N. S.
Feb. 24th, 1823	Cured	....	....	do do vol. ii., N. S.
April 2d, 1823	Cured	....	....	Edinburgh Med. & Surg. Journ., vol. xxvii
May 30th, 1823	Died	28th of July	Gangrene of limb	Lectures by Tyrrell.
....	Died	4th day	Gangrene of limb	London Med. and Phys. Journ., vol. iii., N. S.
Jan. 25th, 1824	Cured after amputation	....	....	Edinburgh Med. & Surg. Journ., vol. xxvii.
Aug. 4th, 1824	Cured	....	....	N. Y. Med. and Physical Journ., vol. iii.
Aug. 18th, 1824	Cured	....	....	Lancet, vol. ii., 1827–28.
Sept. 2d, 1824	Died	7th day	Tetanus	N. Y. Med. and Physical Journ., vol. iii.
Oct. 4th, 1824	Died	11th day	Gangrene of limb	Lancet, October, 1824.
....	Died	26th day	Diarrhœa	Archives Générales, vol. v., 1824.
Jan. 21st, 1825	Died	3d day	Gangrene of limb	Lancet, January, 1825.
Aug. 21st, 1825	Cured	....	....	London Med. and Phys. Journ., vol. lv.
Oct. 28th, 1825	Died	12 weeks after	Bursting of aneurism of aorta	do do vol. lv.
May 17th, 1826	Died	8th day	Gangrene of limb	Méms. de l'Acad. Roy. de Méd., tom. iii.
Feb. 20th, 1826	Died	7th day	....	London Med. and Phys. Jour., vol. i., N. S., 1826.
March 10th, 1826	Cured	....	....	Midland Medical & Surg. Journ., vol. iii.
March 29th, 1826	Cured	....	....	Surgical Reports, 1832.
May 14th, 1826	Died	....	Gangrene of limb	Surgical Reports.
June 2d, 1826	Died after amputation	Aug. 12th	Gangrene of limb	do do
July 9th, 1826	Cured	....	....	do do
July 26th, 1826	Cured	....	....	Med. Repos., vol. vi., 1828.
Nov. 15th, 1826	Cured	....	....	Surgical Reports.

No.	Surgeon.	Sex.	Age.	Right or left side.	Disease or injury.	Duration of disease.	Ligature separated.
103	Ehrmann	M.	43	Right side	Popliteal aneurism	9 months	22d day
104	Lallemand	M.	45	Right side	Pulsating tumor of head of tibia	....	36th day
105	Dickinson	M.	...	Right side	Wounded femoral	....	17th & 24th days[1]
106	Lisfranc	M.	23	....	Wounded femoral	....	10th & 11th days[1]
107	Carlisle	M.	46	Right side	Popliteal aneurism	2 months	....
108	Dupuytren	M.	35	....	Popliteal aneurism	....	....
109	Dupuytren	M.	...	Right side	Popliteal aneurism	4 months	17th day
110	Briggs	M.	30	....	Popliteal aneurism	....	21st day
111	Pierpont	M.	30	....	Femoral aneurism	5 weeks	....
112	Guthrie	M.	26	Left side	Popliteal aneurism	2 months	17th day
113	Guthrie	M.	33	Left side	Popliteal aneurism	6 weeks	31st day
114	S. Cooper	M.	48	Left side	Popliteal aneurism	5 years	....
115	Collis	...	...	....	Popliteal aneurism	....	17th day
116	Tyrrell	M.	58	....	Popliteal aneurism	6 weeks	58th day
117	Mayo	F.	54	Right side	Femoral aneurism	2 months	22d day
118	Moulinié	M.	49	....	Femoral aneurism	2 years	29th day
119	Syme	M.	25	Left side	Popliteal aneurism	3 weeks	....
120	McFarlane	M.	42	....	Secondary hemorrhage after amputation of leg	....	16th day
121	Green	M.	38	Right side	Aneurism of posterior tibial	1 year	39th day
122	Collis	M.	30	Left side	Popliteal aneurism	2 months	....
123	Morrison	M.	37	Right side	Femoral aneurism	....	17th day
124	Morrison	M.	26	Right side	Popliteal aneurism	....	17th day
125	Collis	M.	38	Right side	Popliteal aneurism	15 years	17th day
126	Collis	M.	38	Left side	Popliteal aneurism	15 years	27th day
127	B. Cooper	M.	41	....	Comp. fracture femur with rupture of femoral artery	....	16th day
128	Breschet	M.	32	Right side	Popliteal aneurism	....	19th day
129	N.R.Smith	M.	30	Left side	Popliteal aneurism	6 months	....
130	N.R.Smith	M.	31	Right side	Femoral aneurism	....	....
131	Travers	M.	45	....	Popliteal aneurism	....	....
132	Barry	M.	44	....	Popliteal aneurism	2 years	60th day
133	Hayward	M.	28	....	Popliteal aneurism	3 weeks	16th day
134	Key	M.	36	Right side	Popliteal aneurism	3 months	46th day
135	Key	M.	26	Left side	Popliteal aneurism	5 weeks	28th day
136	Perry	M.	47	Left side	Varicose aneurism of femoral	4 years	....
137	At Meath Hospital	M.	...	....	Popliteal aneurism	....	....

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[1] Double ligature.

Date of operation.	Result.	Period of death.	Cause of death.	Work.
May 11th, 1827	Cured	....	....	Répert. d'Anat., tom v.
April 4th	Cured	....	....	do do tom. ii.
March 25th, 1828	Cured	....	....	Amer. Journ. Med. Sci., vol. iv., 1829.
June 3d, 1828	Cured	....	....	Amer. Journ. Med. Sci., vol. iv., 1829.
Aug. 9th, 1828	Died	Begin'ing of Sept.	Gangrene of limb	Lancet, vol. i., 1828–29.
Feb. 20th, 1828	Died	27th day	Gangrene of limb	Lancet, vol. ii., 1828–29.
Feb. 16th, 1829	Died	26th day	Dry gangrene of limb	Med. Chirurg. Review, vol. xi., N. S., 1829.
March 6th, 1829	Cured	....	....	Guthrie's Diseases of Arteries, 1830.
Oct. 4th, 1829	Cured after amputation	....	....	Midland Med. and Surg. Journ , vol. ii.
April 10th, 1830	Cured	....	....	Med. Chir. Rev., vol. xiii.
May 15th, 1830	Cured	....	....	do do vol xiii.
April, 1830	Cured after amputation	....	....	Med. Chir. Trans., vol. xvi.
Jan 22d, 1831	Cured	....	....	Cyclop. of Anat. & Pys., vol i. p. 236.
Feb. 25th, 1831	Cured	....	....	Med. Chir. Rev., vol., xvi.
May 20th, 1831	Cured	....	....	London Med. and Phys. Journ., vol. xi., 1831.
Aug. 23d, 1831	Cured	....	....	Journal Hebdomadaire.
Aug. 30th, 1831	Cured	....	....	Edin. Monthly Journal, vol. for 1842.
Dec. 19th, 1831	Cured	....	....	Surgical Reports, p. 279.
Sept. 21st, 1832	Cured	....	....	South's Trans. of Chelius, vol. ii.
Nov. 12th, 1832	Cured	....	....	Dub. Med. Journ., vol. v.
Dec. 13th, 1832	Cured	....	....	Amer. Journ. Med. Sci., vol. xix.
Jan. 30th, 1833	Cured	....	....	do do vol. xix.
Nov. 10th, 1833	Cured	....	....	Dub. Med. Journ., vol. v.
Dec. 14th, 1833	Cured	....	....	do do vol. v.
February 9th	Cured	....	....	Surgical cases.
February 18th	Died	28th day	Gangrene of limb	Méms. de l'Acad. Roy. de Méd., tom. iii.
August, 1834	Cured	....	....	Baltimore Med. & Surg. Journ., vol. ii.
March 4th, 1835	Cured	....	....	N. A. Archives of Med. & Surg., vol. ii.
Sept. 5th, 1834	Cured after amputation	....	....	On Constitutional Irritation, 1835.
March 27th, 1834	Cured	....	....	Lancet, vol. i., 1834–35.
Dec. 27th, 1834	Cured	....	....	Boston Medical and Surg. Journ., vol. xxi., 1835.
May 26th, 1835	Cured	....	....	Guy's Hospital Reports, vol. i.
Oct. 6th, 1835	Cured	....	....	do do vol. i.
Sept. 10th, 1835	Died	6th day	Hemorrhage	Med. Chir. Trans., vol. xx.
....	Died	16th day	Phlebitis	Porter in Cyclop. of Anat., vol. i

No.	Surgeon.	Sex.	Age	Right or left side.	Disease or injury.	Duration of disease.	Ligature separated.
138	Englehardt	M.	19	....	Supposed popliteal aneurism	3 weeks	....
139	Morrison	M.	33	Left side	Popliteal aneurism	....	17th day
140	Syme	M.	39	Left side	Popliteal aneurism	4 months	19th day
141	Klingsohr	M.	39	....	Femoral aneurism	....	14th day
142	B. Cooper	M.	28	Right side	Popliteal aneurism	2 weeks	11th day
143	Syme	M.	51	....	Popliteal aneurism	3 months	19th day
144	Busk	M.	37	Left side	Popliteal aneurism	5 weeks	....
145	Turner	...	...	....	Popliteal aneurism	....	....
146	Bougard	M.	35	....	Popliteal aneurism	5 months	....
147	Morrison	M.	42	Right side	Popliteal aneurism	12 months	29th day
148	Harris	M.	30	Left side	Varicose aneurism of femoral	15 months	Removed on 22d day
149	Auchinloss	M.	...	Left side	Popliteal aneurism	2 months	16th day
150	Blandin	M.	29	Right side	Popliteal aneurism	....	19th day
151	Norris	M.	32	Left side	Pulsation tumor of head of tibia	6 months	17th day
152	Phillips	M.	46	Left side	Popliteal aneurism	20 days	19th day
153	Shipman	M.	30	....	Popliteal aneurism	2 months	20th day
154	Lawrie	F	23	Left side	Popliteal aneurism	5 months	15th day
155	Lenoir	M.	37	Right side	Popliteal aneurism	....	17th day
156	Lenoir	M.	49	Left side	Popliteal aneurism	6 months	....
157	Bullock	M.	41	....	Popliteal aneurism	6 months	24th day
158	Syme	M.	26	Left side	Popliteal aneurism	3 months	25th day
159	Lawrie	M.	22	Left side	Popliteal aneurism	2 years	15th day
160	Syme	M.	29	Right side	Popliteal aneurism	1 month	....
161	....	M.	...	....	Popliteal aneurism	....	....
162	B. Cooper	M.	33	Right side	Popliteal aneurism	5 weeks	23d day
163	B. Cooper	M.	55	Left side	Popliteal aneurism	18 weeks	23d day
164	B. Cooper	M.	28	Left side	Popliteal aneurism	3 months	....
165	Lawrie	M.	31	Right side	Popliteal aneurism	2 months	15th day
166	Syme	M.	33	Right side	Popliteal aneurism	1 month	38th day
167	Gutteriez	M.	25	Left side	Femoral aneurism	....	18th day
168	Gutteriez	M.	25	Right side	Popliteal aneurism	....	23d day
169	Syme	M.	17	Left side	Femoral aneurism from wound	3 months	18th day
170	Lizars	M.	46	Left side	Popliteal aneurism	5 months	35th day
171	Syme	M.	62	....	Hemorrhage after fractured leg	....	38th day
172	Teale	M.	30	Right side	Popliteal aneurism	1 month	17th day
173	Quain	M.	50	Left side	Popliteal aneurism	18 months	31st day
174	Syme	M.	25	Left side	Popliteal aneurism	3 weeks	37th day

Date of operation.	Result.	Period of death.	Cause of death.	Work.
....	Died	....	....	Gazette Médicale, 1835.
Mar. 23d, 1836	Cured	....	....	Amer. Journ of Med. Sci., vol. xix.
May 9th, 1836	Cured	....	....	Edin. Med. & Surg. Journ., vol. xlvi.
July 15th	Cured	....	....	Archives Générales, tom. xliv.
July 20th, 1836	Cured	....	....	Guy's Hosp. Rep's, vol. i.
July 22d, 1836	Cured	....	....	Edin. Med. & Surg. Journ., vol. xlvi.
July 24th, 1836	Cured	....	....	Lond. Med. Gaz., vol. xix.
....	Died after amputation	....	Gangrene	Edin. Med. & Surg. Journ., vol. xlvi.
1836	Cured	....	....	Gaz. Méd., No. 15, 1844.
Jan, 15th, 1837	Cured	....	....	Amer. Journ. of Med. Sci., vol. xxii.
July 11th, 1837	Died	1 month after	Gangrene of limb and hemorrhage	Amer. Journ. of Med. Sci., vol. i., N. S., 1841.
Oct. 8th, 1837	Cured	....	....	Lond. Med. Gazette, vol. i., 1842–43.
May 24th, 1838	Cured	....	....	Gazette des Hôpitaux, No. 98, 1838.
Sept. 22d, 1838	Cured	....	....	Amer. Journ. of Med. Sci., vol. xxv.
....	Cured	....	....	Lond. Med. Gazette, vol. i., 1838–39.
June 18th, 1839	Cured	....	....	Boston Med. & Surg. Journ., vol. xxiv.
Sept. 22d, 1839	Cured	....	....	Lond. Med. Gazette, vol. i., 1842–43
Oct. 3d, 1839	Cured	....	....	Archives Générales, tom. i., 4e série.
1839	Cured	....	....	do do tom. i., 4e série.
Oct. 30th, 1839	Cured	....	....	Lond. Med. Gazette, vol. ii., 1840.
Dec. 3d, 1839	Cured	....	....	Lond. and Edin. Monthly Journ., vol. i.
April 1st, 1840	Cured	....	....	Lond. Med. Gazette, vol. i., 1842–43.
April 30th, 1840	Cured	....	....	Lond. and Edin. Monthly Journ., vol. i.
July 4th, 1840	Died	15th day	Phlebitis	Porter on Aneurism.
Sept. 8th, 1840	Cured	....	....	Guy's Hosp. Rep's, vol. vi.
Oct. 6th, 1840	Cured	....	....	do do do vol. vi.
Dec. 26th, 1840	Cured	....	....	do do do vol. vi.
Nov. 24th, 1840	Cured	....	....	Lond. Med. Gazette, vol. i., 1842–43.
Feb. 17th, 1841	Cured	....	....	Lond. and Edin. Monthly Journ., vol. ii.
Mar. 4th, 1841	Cured	....	....	Annales de Chir., tom. iv.
Mar. 26th, 1841	Cured	....	....	do do do tom. iv.
May 26th, 1841	Cured	....	....	Lond. and Edin. Monthly Journ., vol. ii., 1842.
May 28th, 1841	Cured	....	....	do do do vol. i., 1841.
June 2d, 1841	Cured	....	....	Edin. Monthly Journ., vol. for 1842.
Aug. 4th, 1841	Cured	....	....	Lond. Med. Gazette.
Aug. 12th, 1841	Cured	....	....	Lancet, vol. i., 1841–42.
Aug. 30th, 1841	Cured	....	....	Lond. and Edin. Monthly Journ., vol ii., 1842.

No.	Surgeon.	Sex.	Age.	Right or left side.	Disease or injury.	Duration of disease.	Ligature separated.
175	Laugier	M.	50	....	Popliteal aneurism	3 weeks	18th day
176	Quain	M.	35	Left side	Popliteal aneurism	5 weeks	17th day
177	Adams	M.	28	....	Popliteal aneurism	....	10th day
178	Mackenzie	M.	18	....	Hemorrhage	....	....
179	Syme	M.	42	Right side	Popliteal aneurism	6 weeks	25th day
180	Fox	M.	12	....	Aneurism of anterior tibial from wound	Some weeks	21st day
181	Phillips	M.	53	Right side	Popliteal aneurism	3 weeks	9th day
182	Lawrie	M.	31	Right side	Popliteal aneurism	10 months	....
183	Lawrie	M.	30	Right side	Popliteal aneurism	....	10th day
184	Harrison	M.	42	Right side	Popliteal aneurism	....	20th day
185	Syme	M.	9	....	Popliteal aneurism	2 years	14th day
186	Nottingham	M.	43	Right side	Popliteal aneurism	7 months	24th day
187	Nelaton	M.	...	....	Pulsating tumor of intern. condyle of femur	....	....
188	Syme	M.	32	Left side	Popliteal aneurism	5 months	21st day
189	Syme	M.	32	Right side	Popliteal aneurism	....	....
190	Hancock	M.	...	Left side	Popliteal aneurism	10 weeks	15th day
191	A. E. Hosack	M.	55	....	Popliteal aneurism	....	26th day
192	Norris	M.	35	Left side	Popliteal aneurism	6 months	26th day
193	Cheesman	M.	25	....	Wounded anter. tibial and interosseal arteries	....	....
194	Syme	M.	42	Right side	Popliteal aneurism	2 months	36th day
195	Toogood	M.	36	....	Popliteal aneurism	1 year	11th day
196	Sabine	F.	40	Right side	Popliteal aneurism	....	....
197	C. B. Gibson	M.	45	Right side	Femoral aneurism	....	18th day
198	Judd	M.	32	Right side	Popliteal aneurism	....	....
199	B. Cooper	M.	30	Left side	Popliteal aneurism	....	22d day
200	Roux	M.	58	Right side	Popliteal aneurism	....	....
201	Bird	M.	38	Right side	Popliteal aneurism	2 years	13th day
202	Bird	M.	38	Left side	Popliteal aneurism	"A few weeks"	7 weeks
203	Roux	M.	45	Left side	Popliteal aneurism	7 months	....
204	Wright	M.	37	....	Popliteal aneurism	6 days	26th day

Date of operation.	Result.	Period of death.	Cause of death.	Work.
Sept. 23d, 1841	Cured	....	....	Annales de Chir., tom. vi.
Oct. 17th, 1841	Cured	....	....	Lancet, vol. ii., 1841.
1841	Died	....	Gangrene	Dub. Med. Journ., vol. xix.
Mar. 31st, 1842	Died	In 24 hours	....	Liston on a Variety of False Aneurism, 1842.
July 19th, 1842	Cured	....	....	Lond. and Edin. Monthly Journ., vol. ii., 1842.
Sept. 17th, 1842	Cured	....	....	Amer. Journ. of Med. Sci., vol. v., N. S., 1843.
1842	Died	43d day	Gangrene of limb	Lond. Med. Gazette, vol., i., 1842.
July 13th	Cured after amputation	....	....	do do do vol. i., 1843.
....	Died after amputation	....	Gangrene of limb	do do do vol. i., 1843.
Nov. 1st, 1843	Cured	....	....	do do do Oct. 1845.
Feb. 24th, 1844	Cured	....	....	Lond. and Edin. Monthly Journ. for 1844.
Oct. 14th, 1844	Cured	....	....	Guy's Hosp. Reports, Oct. 1845.
Mar. 10th, 1845	Cured	....	....	Lancet, vol. i., 1845.
Sept. 17th, 1845	Cured	....	....	Monthly Journ. of Med. Sci., 1846.
Nov. 26th, 1845	Cured	....	....	do do do 1846.
Sept. 6, 1845	Cured	....	....	Lancet, vol. ii., 1845.
March, 1846	Cured	....	....	N. Y. Journ. of Med. & Coll. Sci., vol. i., N. S., 1848.
April 22d, 1846	Cured	....	....	At Pennsylvania Hospital.
July 7th, 1846	Died	25th day	Phlebitis	Annalist, vol. i., 1846.
Oct. 2d, 1846	Cured	....	....	Month. Journ. of Med. Sci., 1846–47.
Mar. 1st, 1847	Cured after amputation	....	....	do do do 1846–47.
Mar. 15th, 1847	Died	9th day	....	Annalist, vol. i.
July, 1847	Cured	....	....	Amer. Journ. of Med. Sci., vol. xiv., N. S., 1847.
Nov. 1st, 1847	Died	14th day	Tetanus	Lond. Med. Gazette, vol. v., 1847.
Mar. 18th, 1837	Cured	....	....	Guy's Hosp. Rep's, vol. ii.
July 31st, 1840	Died	19th day	Phlebitis	L'Expérience, tom. vi.
Jan. 7th, 1837	Cured	....	....	Lancet, vol. i., 1837–38.
Mar. 7th, 1837	Cured	....	....	do vol. i., 1837–38.
June 13th, 1835	Died after amputation	....	Gangrene	Thèse of Figuière, 1845.
1848	Cured	....	....	Lancet, vol. i., 1849.

Mortality.—The foregoing table contains a list of two hundred and four cases in which the femoral artery has been ligatured by the Hunterian method. Of these, one hundred and fifty-four recovered, and fifty died. Six of the patients who recovered undergoing amputation in consequence of gangrene of the limbs.

Disease or injury.—Of the whole number of cases contained in the tables, the artery was tied in one hundred and fifty-five, for the cure of popliteal aneurisms; in twenty-two, for femoral aneurisms; in six, for aneurismal tumors of the leg; in four, for pulsating tumors of the head of the tibia or condyle of the femur; in five, for varicose aneurisms; in three, for rupture of the artery, accompanying fractures of the leg or thigh; in eight, in order either to prevent or abate inflammation after wounds or dislocations, or to arrest hemorrhage, either primary or secondary; and in one, for a supposed popliteal aneurism.

Of the one hundred and eighty-eight cases in which the operation was done for the cure of aneurisms, one hundred and forty-two were cured, and forty-six died.

Sex.—Of one hundred and eighty-three cases of aneurisms, in which this is noted, one hundred and seventy-seven occurred in males, and six in females.

Right or left side.—Of one hundred and twenty-four cases of aneurisms where the side is mentioned, sixty-three were on the right and sixty-one on the left side.

Age.—The age is noted in one hundred and sixty-four cases of aneurisms, and of these there were:—

Under 10 years	1	a true	aneurism
Between 10 and 20	4	"	"
" 20 and 30	30	"	"
" 30 and 40	72	"	"
" 40 and 50	40	"	"
" 50 and 60	14	"	"
60, and above,	3[1]	"	"
Total	164		

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[1] One of these was a female, aged ninety, who is stated to have been living and well three years after the operation was performed.

Period the ligature separated.—In one hundred and thirty-cases[1] in which the ligature separated spontaneously, it came away in ninety-one before the twentieth day; in thirty-seven, between the twentieth and thirtieth days; in fourteen, between the thirtieth and fortieth days; and in five, beyond the fortieth day. The longest period to which it remained was the sixtieth day, and the shortest the fifth day.

Return of pulsation in the aneurismal tumor after the application of the ligature.—This was observed in nineteen cases. In No. 23, a slight pulsation in the sac was observed on the day following the operation, on the next day it was more distinct, but two days afterwards it became much less. The patient recovered. In No. 25, some pulsation was observed in the tumor on the fourth day after the operation, and the patient died on the twelfth day of hemorrhage. In the third case, No. 60, pulsation appeared in the tumor on the day after the operation, but ceased on the sixteenth day, the patient recovering. In No. 67, nine months after recovery from the operation, the tumor, which had diminished so much as to have become barely perceptible, and was without pulsation, reappeared, and pulsation in it became distinct. The cure was finally completed by compression. In the fifth case, No. 78, the artery was ligatured April 27th, 1821. On the 20th of July, 1825, he was readmitted, and stated that the tumor had entirely disappeared soon after he was discharged in 1821, but that, five or six weeks before his readmission, he observed that its swelling had returned at the upper part of the ham, and was at that time nearly of the size of a hen's egg. It was proposed to take up the artery between the part tied in the former operation and the aneurismal sac; but, as the first operation had not succeeded, the patient preferred amputation. He died eight hours after it. The femoral was found to be obliterated, for the space of half an inch, at the part where the ligature had been applied four years before. Immediately below it, two small branches were observed to enter the continued trunk of that vessel. These were equal to half the diameter of the femoral vessel. The anastomosing branches given off above the obliterated portion were a good deal enlarged. In No. 82, the disease was a femoral aneurism, and the artery was tied in April, 1823. On the 25th of January following, he had a return of pulsation in the tumor, which disappeared under the application of cold and compression. In No. 95, all pulsation in the tumor ceased upon tightening the ligature, but returned in a few minutes. In half an hour after the operation it was nearly as distinct as before the artery was tied, but on the third day the pulsation ceased. The patient died; and on dissection, the femoral artery, just below the part where the profunda was given off, was found to be divided into two nearly equal branches. These ran down parallel to each other, to the part where the artery passes through the tendon of the triceps muscle, when they again united. The ligature had been placed on the most superficial vessel.[1] In the eighth case, No. 96, which was one of varicose aneurism at the middle of the thigh, with an aneurismal varix near the ankle, pulsation was observed in the varix at the ankle on the fourth day; the patient recovered, but was not cured. In the year after the operation, the tumor was stationary with the same pulsation. In No. 102, aneurismal tumors existed in both the anterior tibial and popliteal arteries: pulsation returned in both on the twelfth day, but ceased four days afterwards, and the patient was cured. In No. 110, the operation was done in March, 1829; pulsation ceased after it, and the tumor diminished in size. He returned to work, and it ultimately entirely disappeared. In the month of September following, the tumor reappeared with pulsation. By the application of a hard compress on the inner part of the thigh, which he wore for two months, night and day, the pulsation ceased, and one year after the operation no appearance of swelling was to be perceived. In No. 134, pulsation in the sac returned the day after the operation, but rapidly disappeared. In No. 136, the disease was a varicose aneurism of the femoral. Four hours after the operation, feeble pulsation was noticed in the tumor, and on the following day it became stronger. The patient died. In No. 144, the operation was done on the 24th of July; on the 31st, indistinct pulsation was observed in the tumor. By the 7th of August it had increased, and is afterwards noticed as present on the 15th and 25th. By the 4th of September it was free from all pulsation. In the fourteenth case, No. 155, pulsation was noticed in the tumor five months after the operation, though it was small and hard; the sac afterwards suppurated, and the case did well. In No. 161, pulsation reappeared in the sac on the tenth day, and gradually increased in violence until the man began to sink. In No. 190, pulsation was noticed in the tumor on the eighth day, and on the twentieth day was no longer perceptible. In the seventeenth case, No. 191, where the operation was performed in March, the pulsation and size of the tumor had returned to nearly its original size and force by the middle of August. Compression on the artery was employed, and at the end of five days removed. After a fortnight, a slight thrill being again detected in it, it was reapplied for thirty-six hours, and a perfect cure effected. In No. 199, the patient had been operated upon, on the same side, six months previously, by M. Greaves, of Manchester. Pulsation returned in the sac twelve hours after it, and the disease was not cured. Upon close examination in the course of the cicatrix, the pulsation of the vessel was discovered, though certainly not of a natural sized artery, nor did any degree of pressure upon this command the pulsations of the aneurismal tumor. In the lower third of the thigh the pulsation of the artery was very perceptible, and pressure here immediately stopped the flow of blood into the tumor. Mr. Cooper believed that the cause of failure of the operation which had been done, was owing, probably, to a high division of the femoral artery into two branches, and tied the vessel low down in the thigh. Immediately upon tightening the ligature, the pulsation in the tumor ceased, but in a few minutes became again as distinct as before the operation. A slight degree of compression was made over the sac. On the following day the pulsation was less perceptible, and two days afterwards it had entirely ceased. During the ten following days the sac had become firm. In the nineteenth case, No. 200, the patient had been operated upon for a popliteal aneurism of the opposite side, three years previously, and was apparently cured, but when he presented himself for the second operation, a pulsating tumor of the size of a hen's egg was found in the ham. Upon examination of the femoral artery of this side, after the death of the patient, it was found to be obliterated for the space of two inches.

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[1] In some of the cases a double ligature was used.

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[1] I have seen it stated that preparations, showing a similar distribution, exist in the Royal College of Surgeons at Dublin, and in St. Bartholomew's Hospital at London.

In addition to these cases, an instance is mentioned by Sir A. Cooper, where an operation for popliteal aneurism was done by Mr. Key, and the disease apparently cured, but a year afterwards the patient returned to Guy's Hospital with the aneurismal tumor nearly of its original size, and he amputated the limb.

Hemorrhage after the operation.—This occurred in twenty-four cases, of which twelve died and twelve were cured, one of the latter being with the loss of a limb. In No. 2, there was hemorrhage from the wound on the nineteenth and twentieth days after the operation, on the last occurrence of which the artery "was tied a little higher up." On the twenty-sixth day it recurred, and the patient died. In No. 7, death took place from hemorrhage on the eleventh day. In No. 23, the operation was done on the 14th of July. On the 24th there was slight hemorrhage from the wound, and on the 26th a return of it, which was arrested by compression. On the 6th of August there was another bleeding, which was again arrested by pressure, and the case did well. In No. 25, bleeding had taken place on the eleventh day, and returned violently on the twelfth, and carried off the patient. In No. 29, hemorrhage took place on the forty-second day after the operation; it again occurred on the following morning, and an hour afterwards the man died. In No. 34, there was bleeding from the wound on the fifth day after the ligature separated, and the patient did well. In No. 111, there was hemorrhage on the fifteenth day, when the limb was amputated, and the patient recovered. In No. 38, the patient died from hemorrhage on the twenty-seventh day. In No. 40, there was bleeding on the twenty-third day; this recurred on the twenty-fourth, when the wound was enlarged and stuffed with lint. The patient was cured. In No. 56, an attempt to remove the ligature was made three days after the operation; two days subsequent to this, in consequence of loss of blood, a second ligature was placed higher up on the artery, and within a few days there was another gush, and the man died. In Nos. 64 and 74, death also took place from hemorrhage. In No. 68, there was hemorrhage from the wound on the sixteenth day, and a recurrence of it on the twenty-second, but the patient recovered. In No. 71, there was some hemorrhage eight days after the separation of the ligature, but it did not again recur, and the patient did well. In No. 92, a small non-pulsating tumor was observed soon after the operation, about the middle of the wound, and the same night an alarming loss of blood from the part took place; the artery was now again secured higher up, and the patient recovered. In No. 100, there was hemorrhage to eight ounces on the nineteenth day, and no bad result followed. In No. 96, hemorrhage took place on the separation of the ligature, on the eleventh day, to the amount of a pint and a half, and the patient recovered. In No. 107, there was slight hemorrhage from the wound on the seventh day, and the patient afterwards died of gangrene of the limb. In No. 122, a cure took place, despite copious hemorrhages on the eighth and thirteenth days. In No. 136, bleeding to a large amount took place on the fifth day, and on the following one it recurred, and he died. In No. 129, there was slight hemorrhage on the twelfth day from around the ligature; this returned on the same evening, and a tumor was observed at the point of the ligature which pulsated, and had attained the size of an orange. On the following day hemorrhage again took place, when the artery was tied above the profunda, and the tumor on the thigh laid open. On the eighth day following this there was another profuse bleeding, which was arrested by compresses and a bandage, and the patient recovered. In No. 130, which was a femoral aneurism, a popliteal tumor of the size of an orange had existed in the same limb, in which a spontaneous cure had taken place after the formation of that in the thigh. The ligature was applied just below Poupart's ligament. On the eleventh day after the operation, hemorrhage to the amount of two pounds took place from the wound, which was stopped by compresses and a spica bandage. On the thirteenth, fifteenth, and seventeenth days, there were returns of the bleeding, but the patient recovered. In No. 193, the femoral was secured, July 7th, on account of a wound of the anterior tibial and interosseal arteries. On the 22d, there was hemorrhage to the extent of thirty-three ounces from the seat of operation, which was arrested by the application of cold and a tourniquet. On the 24th, in consequence of a renewal of it, the external iliac was tied. On the 26th, there was another alarming hemorrhage, when the saphena vein and a branch of the profunda were taken up. The patient died September 1st. In No. 200, there was a slight hemorrhage previous to death on the nineteenth day.

Suppuration of the sac.—This occurred, after the operation for aneurism, in sixteen cases; and of these, six died and ten did well. In No. 3, it is stated that the sac opened after the operation, but healed up like any other sore. In No. 19, on the fifth day after the operation, fluctuation became evident and the tumor was laid open. The patient died. In No. 7, fluctuation in the sac was noticed on the ninth day, and on the eleventh it burst, and the patient died of hemorrhage. In No. 26, at the end of a month, fluctuation was perceived in the tumor, and it was laid open. The patient died. In No. 31, the sac opened and discharged during the cure. In No. 38, an eschar formed on the tumor, after the operation, which discharged fetid matter. Warm milk and water were thrown into the sac, and on the same evening there was profuse hemorrhage from it. To arrest this, amputation of the limb was done, soon after which the patient died. In No. 52, the tumor sloughed, one month after the ligature, and the patient recovered. In No. 53, the operation was done in October, 1813, and in the autumn of the following year the sac suppurated, was opened, and cicatrized. In No. 69, the tumor suppurated, and was opened, on the fifteenth day after the operation, and the patient recovered. In No. 73, on the seventh day after the ligature of the vessel, the integuments covering the tumor were mortified, and an opening into it was made and its contents set free. The patient died. In No. 81, the skin over the sac, which was gangrenous at the time of the operation, sloughed on the fourth day. In No. 92, there was suppuration of the sac, which was opened and the patient cured. In No. 111, the tumor, which had been punctured before the artery was tied, afterwards suppurated and discharged. The man was cured after amputation. In No. 155, the sac suppurated more than five months after the operation, when an incision was made into it and the patient cured. In No. 160, the tumor suppurated and discharged itself, and the patient recovered. In No. 181, heat of tumor was observed on the eighth day after the application of the ligature; three days after this fluctuation was evident, and an exit was given to the pus. The patient died.

Gangrene of the limb.—This followed in thirty-one out of the two hundred and four cases contained in the tables, and it in no case occurred except where the operation was done for aneurisms. Of these thirty-one cases, Nos. 12, 19, 35, 58, 64, 83, 84, 89, 91, 94, 107, 108, 109, 128, 177, and 181, sunk at various periods after the operation. In No. 16, the last phalanges of the toes sloughed, as also a spot on the inferior part of the leg, and a portion of the fifth metatarsal bone exfoliated. The patient recovered. In No. 36, the operation was done on the 24th of July; mortification followed on the third day after it; amputation was done on the 16th of August, six days after which the patient died. In No. 85, the artery was tied on the 25th of January. On the 30th, symptoms of gangrene set in, and on the first of February, the thigh was successfully amputated immediately below where the artery was tied. The gangrene in this case is stated to have been caused by the employment of fomentations of hot salt, notwithstanding strict injunctions to the contrary. In Nos. 97 and 98, the patient had aneurismal tumors in both hams; the left artery was first tied, and gangrene of the foot followed it.

The ligature on the right limb was done at the request of the patient; gangrene occurred in it also, and death followed. In No. 99, mortification took place on the ninth day; the limb was amputated on the thirty-fourth day, and the man died. In No. 114, the limb is stated to have been threatened with gangrene before the vessel was tied—it followed the operation, and the man was cured after amputation. In No. 131, the ligature was applied on the 5th of September; profuse hemorrhage occurred in opening the sheath of the vessels. Gangrene immediately followed. Amputation above the knee was done on the 18th, and the patient recovered. In No. 145, amputation was done a week after the operation, in consequence of mortification, and was followed by death. In No. 148, the operation was followed by gangrene of the limb, and the thigh was removed unsuccessfully. In No. 182, gangrene appeared on the third day; amputation was done, after a line of demarcation was formed, and the patient recovered. In No. 183, the limb was amputated on the 22d day, and was followed by death in three hours. In No. 195, the tumor had burst previous to the operation, which was done on the 1st of March; gangrene of the foot and leg followed, and on the 8th the thigh was amputated, and the patient got well. In No. 198, symptoms of mortification appeared on the third day, after which trismus set in and the man died. In No. 203, the operation was followed by gangrene of the foot and leg. The thigh was amputated during its progress, seven days after which death occurred from gangrene of the stump.

Cause of death.—Of the two hundred and four cases contained in the tables, fifty died. Of these, twenty-three died from mortification of the limb; eight from hemorrhage; five from phlebitis; three from tetanus; two from hectic and diarrhœa; one from thoracic inflammation and abscesses in the course of the artery; one from sloughing of the sac; one from the bursting of an aneurism of the aorta within the pericardium twelve weeks after the operation; one from fever; one from absorption of pus; and in four the cause is not noted.

Mistakes in diagnosis.—In four of the cases included in the tables, mistakes in diagnosis occurred. In No. 83, the precise nature of the tumor could not be ascertained, and it was punctured before the operation. In No. 111, the tumor was mistaken for an abscess, and opened a week previous to the operation; after bleeding three pints it ceased spontaneously. In No. 138, the tumor was of the size of a goose's egg, distinctly pulsated, and was said to have shown itself suddenly, while walking, three weeks previously. Compression was at first attempted, and afterwards the artery was tied, notwithstanding which the swelling continued to increase. On post-mortem examination, it was found to consist partly of a fibrous tissue divided into lobes, and in part of a soft substance containing cells filled with a serous fluid. The artery ran over the tumor between two of the sacs, and through these its pulsations had been so communicated as to give the sensation of the whole tumor pulsating. The right lung was converted into a brain-like mass. In No. 196, the patient was a black woman, in whom there existed great swelling of the whole limb, but particularly of the popliteal region. Suspecting deep suppuration, an incision, an inch in length, was made into it, from which nothing but a little serum, slightly colored with blood, escaped. The integuments in the popliteal region afterwards ulcerated, and some days subsequently there was a profuse hemorrhage from the part when the artery was tied.

Two very instructive cases of mistake in the diagnosis of popliteal tumors have been published by Mr. Lawrence, of London, which I will here take the liberty of referring to. The first (*Medico-Chirurgical Transactions*, vol. viii. p. 497) was that of a large aneurism filling up the whole ham, and extending on both sides of the femur towards the front of the limb. It had begun behind, and had existed for five months; had a firm, fleshy feel, being a little softer at one of its anterior protuberances than in other parts; was not tender on handling, but gave the patient great pain. The surgeons of St. Bartholomew's, in consultation, viewing it as a large and rapidly increasing tumor, recommended amputation, which Mr. L. did, having first plunged a lancet into the softest part of the swelling, to the whole depth of the blade, without giving issue to any fluid. Examination of the amputated limb showed the tumor to be a popliteal aneurism, containing an immense mass of firm bloody coagulum, and although the sac had been freely penetrated by the abscess lancet, no part of its contents escaped. The eminent surgeon who records this adds, that he "has stated the case to put others on their guard; and shall be happy if what he has said should, in any instance, prevent so serious mutilation as that which his patient suffered."

The second case was that of a man, aged thirty, with a swollen and painful state of the right knee-joint, consequent upon a fall. Shortly after, a swelling arose immediately above the knee, and gradually extended around the back part and sides of the thigh. Near the tendon of the triceps a softening of the swelling indicated the probability of its containing matter, and a small incision was made into it, from which about four ounces of arterial blood flowed. On examining the swelling more closely, pulsation in it was now discovered, and it was agreed that sufficient ground existed for believing the tumor to be a popliteal aneurism, and accordingly the femoral was tied. The pulsation immediately ceased, and its size gradually diminished; but, after some time, it again enlarged, became painful, the skin covering it sloughed, and the slough extended into the tumor, and the man shortly after died. The tumor was found to consist of a soft fibrous and dense osseous tissue—the latter originating from the femur. The femoral and popliteal vessels were sound.

Difficulties of, and accidents during, the operation.—In eleven of the two hundred and four ligations of the femoral artery, the crural vein was either included in the ligature, or wounded in the operation. In Nos. 2 and 90, the vein as well as the artery was tied. In Nos. 13, 73, 94, 107, and 159, the vein was wounded in the operations. In No. 74, the ligature was found to have passed through the vein. In No. 131, profuse hemorrhage occurred on opening the sheaths of the vessels. In No. 146, the vein was wounded during the operation; the patient recovered and lived four and a half years after it. On dissection, it was found to be obliterated to the extent of three inches. In No. 161, the vein was pricked in the operation, and a small portion of it included in the ligature along with the artery. It may be well here to mention that a case occurred to Sir A. Cooper, where the patient placed himself upon the table, for the purpose of undergoing ligature of the femoral vessel for a popliteal aneurism, and died before the first incisions were concluded, in consequence of the bursting of an aneurism of the aorta.

In the *Southern Journal of Medicine and Surgery* for May, 1848, an interesting case of false aneurism in the thigh is related, in which an attempt was made to ligate the femoral artery at the crural arch. A ligature was passed around what was supposed, by all present, to be the artery, but on post-mortem examination it was found that it embraced a portion of a tendon, and that the femoral artery was not tied. The patient was so exhausted from previous hemorrhage, at the time of the operation, that no pulsation could be felt in either of the lower extremities.

Aneurisms on both sides.—Of the cases of aneurism included in the tables, nine presented popliteal aneurisms on both sides. In Nos. 22 and 23, both aneurisms were observed when the patient presented himself to his surgeon. The left, at the time of the first operation, was small, and increased rapidly after the ligature of the first artery. In Nos. 60 and 61, the aneurism of the left side did not exist at the time of the operation upon the right. In Nos. 79 and 80, the tumor on the right side showed itself but a few weeks before the second operation. In Nos. 97 and 98, the aneurisms were both large, and of seven months' standing; the right artery was tied two months after that of the left. In Nos. 125 and 126, the aneurisms occurred simultaneously, and had existed for fifteen years. In Nos. 129 and 130, there was incipient disease of the right ham at the date of the operation upon the left. In Nos. 167 and 168, the second tumor did not make its appearance till after the cure of the first. In Nos. 188 and 189, the disease seemed to be beginning on the right side at the time of the first operation. In Nos. 201 and 202, the tumor in the left ham was noticed some time after that of the right side had been operated upon. No. 84 was also a subject of aneurism in each ham. In No. 197, the tumor in the ham was first observed about ten days after a ligature had been placed on the external iliac of the opposite side for the cure of a femoral aneurism. No. 20 had been the subject of popliteal aneurisms of both sides, and the left limb was amputated some time previous to the ligature of the vessel of the right side. In No. 200, also, the artery on the left side had been tied three years previously for a popliteal aneurism.

Pulsating tumors of the head of the tibia, or condyle of the femur.—Four cases are included in the tables in which the femoral artery was ligatured for the cure of these affections. They all recovered; but in two of them, although cures appeared to follow, there were afterwards returns of the disease. In No. 68, the limb was amputated between three and four years after the ligature had been applied, the tumor having attained a great size. In another, which occurred to the writer, although the ligature of the vessel was apparently followed by a cure of the disease, the tumor returned, and, eleven months after it, I amputated the limb. In three of the cases in which the vessel was tied for these tumors (Nos. 68, 151, and 187), pulsation reappeared; in the first on the sixteenth day, but soon ceased; in the second on the seventeenth day, and ceased on the twenty-sixth day; and in the third on the seventh day.

Varicose aneurisms.—The foregoing tables contain five cases of varicose aneurisms of the lower limb. Four of these proved fatal, and in one no benefit was received from the operation. In No. 64, where the disease was situated on the posterior tibial artery, death occurred from gangrene of the limb and hemorrhages. In No. 94, where the femoral was affected, the operation was soon followed by gangrene and death. In No. 96, the disease was situated in the middle of the thigh, and the ligature was placed as nearly as practicable to the sac. The case went on favorably till the separation of the ligature on the eleventh day, when the patient came near losing his life from hemorrhage, and was in no way benefited by the operation. The contents of the tumor never coagulated, nor did the tumor decrease, and in the following year it remained stationary, with as much pulsation as before. In No. 136, death soon followed the ligature of the artery, and, on dissection, the vessel was found to be enlarged nearly to the size of the aorta, with its coats so thin as to give it nearly the appearance of a vein. In No. 148, the artery was tied immediately below Poupart's ligament. It was followed by mortification of the limb, and the thigh was removed six inches below the hip-joint. There was afterwards a return of the disease, and secondary hemorrhage terminated life.

In connection with the above instances of varicose aneurism, in which the femoral artery has been tied, it may be interesting to contrast their results with those in which either the external iliac has been secured, or other treatment has been adopted, for the same affection. In the case of Baroni, where the disease was seated in the inguinal region, and the external iliac was taken up, an incision was made into the sac on the forty-fifth day, in consequence of repeated bleedings, with the view of securing all the vessels. The hemorrhage was so frightful, that the patient was only saved from dying on the table by making strong compression, and death occurred eleven days after. In Dr. Fleischer's patient, where the affection occupied the middle of the thigh, and an incision into the sac was made, the fatal result took place from like causes. In the history reported by Hennen, where the external iliac was tied, the affection being seated in the upper third of the thigh, gangrene and death speedily followed; and in the case of Dr. Morrison, ligature of the external iliac was also made for a like affection, seated at the same part, and death in a short time terminated the sufferings of the patient. In the instance reported by Lallemand, where the disease was seated above the middle of the thigh, and was of five years' continuance, the femoral artery was first tied a little below Poupart's ligament. On the sixth day, in consequence of hemorrhage, the external iliac was ligatured, and on the same evening the bleeding again recurred, and he died. In a case recently published by Dr. Mott, the disease occupied the upper part of the thigh, and had existed for two and a half years. A ligature was applied to the external iliac; gangrene supervened, and the man died on the sixth day.

Observation, however, shows that varicose aneurisms in the lower extremity, after a certain lapse of time, in several cases have become stationary; and instances are recorded in which the affection has continued for years, causing but little inconvenience. In 1820, a patient fell under the notice of M. Dupuytren, with a large varicose aneurism of the upper part of the thigh, which had continued for twelve years without injuring the health, or in any way interfering with the free use of the limb; and in the spring of 1835, a patient was in the wards of M. Velpeau, at La Charité, in whom a like affection, seated high up in the thigh, had existed for more than twenty years, without materially interfering with the use of his member. A few years since, I had an opportunity of examining, along with several other surgeons of this city, a case of long continuance, which inconvenienced, though it did not distress, the patient. In face of these facts it is, in my opinion, no longer a question whether or not operative measures should be resorted to in the lower limb in the treatment of such cases. Sound surgery condemns it. The affection does not necessarily compromise life, or the free use of the member; and resort to the knife should not be had so long as the infirmity can be made at all bearable by the use of compresses, laced bandages, and other like means. If in any case an operation for varicose aneurism in the lower extremity is absolutely demanded, all reasoning, as well as experience on the subject, goes to show that no good result can be expected from the application of a ligature by Hunter's method.

The following is a summary of the reported cases of femoral and popliteal aneurisms which have been treated by pressure since 1842. They have, with two or three exceptions, been derived from Mr. Bellingham's Tract on Aneurism, and the Report on Surgery, contained in the first volume of the *Transactions of the American Medical Association.*

No.	Surgeon.	Sex.	Age.	Seat of aneurism.	Duration of disease.	Duration of compression.	Result.
1	Hutton	Male	30	Popliteal	10 days	28 days	Cured.
2	Cusack	Male	55	Popliteal	7 days	31 days	Cured.
3	Bellingham	Male	32	Popliteal	3 months	2 days	Cured.
4	Liston	Male	30	Femoral	2 months	56 days	Cured.
5	Harrison	Male	29	Popliteal	1 month	93 days	Cured.
6	Liston	Male	53	Femoral	2 months	30 days	Cured.
7	Bellingham	Male	33	Femoral	10 days	43 days	Cured.
8	Kirby	Male	28	Popliteal	3 months	53 days	Cured.
9	Allan	Male	32	Popliteal	3 weeks	57 days	Cured.
10	Greatrex	Male	27	Popliteal	....	21 days	Cured.
11	Cusack	Male	26	Popliteal	1 month	7 days	Cured.
12	Porter	Male	29	Popliteal	2 months	24 days	Cured.
13	Cusack	....	30	Popliteal	....	About 20 days	Died suddenly from disease of the heart 48 hours after pressure had been removed. All pulsation had ceased.
14	Porter	Male	..	Popliteal	9 months	20 days	Cured.
15	O'Ferral	Male	32	Popliteal	3 weeks	33 days	Cured.
16	Jolley	Male	38	Popliteal	4 months	40 days	Cured.
17	Macdonnell	....	..	Popliteal	6 months	....	Cured.
18	Dartnell	Male	38	Popliteal	3 weeks	7 days	Cured.
19	Mackern	Male	30	Femoral	9 months	36 days	Cured.
20	Stork	Male	32	Popliteal	7 or 8 months	91 days	Cured.
21	Stork	Male	24	Popliteal	2 months	22 days	Cured.
22	Cusack	Male	33	Popliteal	16 days	43 days	Cured.
23	Sunter	Male	43	Popliteal	6 weeks	Several days	Cured.
24	Bellingham	Male	38	Popliteal	8 months	Pulsation continuing some time after compression, a galvanic current was passed through the sac. Seven days after this he was seized with erysipelas, and died six days afterwards.	
25	St. Vincent's Hospital	....	..	Popliteal	....	....	Cured.
26	Armstrong[1]	Male	26	Popliteal	....	106 days	Cured.
27	Harrison	Male	42	Popliteal	Some months	A fortnight, when the operation was performed at the request of the patient.	
28	Humphrey	Male	31	Femoral	3 weeks	2 days	Cured.
29	Buck	....	..	Femoral	....	Fairly tried	Failure and the operation performed.
30	Rodgers	Male	47	Popliteal	2 months	31 days	Cured.
31	Watson	Female	38	Femoral	1 month	70 hours	Cured.
32	Mütter	Male	41	Popliteal	6 weeks	54 days	Cured.
33	Knight[2]	Male	48	Popliteal	Several months	40 hours	Cured.
34	Hosack	Male	55	Popliteal	....	5 days. After a fortnight, a slight thrill being detected in the tumor, it was reapplied for 36 hours	Cured.
35	Tufnell	Male	27	Popliteal	4 months	9 days	Cured.
36	Tufnell	Male	28	Popliteal	A few days	46 days	Cured.
37	Hutton	Male	..	Popliteal	2 months	7½ hours, and after an interval of a week 3 hours longer	Cured.

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[1] In this case, pressure was made upon the tumor, not upon the artery above it.

[2] In this case, manual pressure, by relays of assistants, alone was used.

VARICOSE ANEURISM AT THE BEND OF THE ARM.

Varicose aneurism at the bend of the arm; ligature of the artery above and below the sac; secondary hemorrhages with a return of the aneurismal thrill on the 10th day; cure.—In May, 1842, I saw in consultation with Dr. Rutter, Mr. K., ætat. 42, on account of a tumor at the bend of the arm, which had followed venesection. The patient, who had a permanent jaundiced appearance, but was enjoying an apparently good state of health, gave the following account of it: In March he was bled at his desire by a bleeder who had performed the same operation for him, and generally in the same arm, some thirty or forty times. Nothing extraordinary occurred, other than that he remarked the flow of blood to be greater, and to be checked with more difficulty than had usually been the case. This was, however, done by firm compression, and on the day following finding the bandage tight, he removed it, and found the orifice to be completely closed. A short time after this, a small pulsating swelling was observed by him at this point, which slowly increased till a day or two previous to my seeing him, when, after some exertion with his arm, he observed a very considerable sudden augmentation in its size. Upon examination, a tumor of the size of a walnut was found at the bend of the arm; this was soft, pulsated strongly, and offered both to the touch and ear the purr and thrill peculiar to varicose aneurism. The vein running over the surface of the tumor was greatly enlarged, and in its centre a cicatrix was perceptible, the skin around it appearing to be exceedingly thin. By pressure the vein could be readily emptied, and when this was done, a pulsating tumor was plainly felt more deeply situated between it and the brachial artery, which by firm pressure could likewise be made to disappear. Compression on the artery above the tumor stopped all pulsation in it, on the removal of which it quickly returned to its original size. The pulse at the wrist was weaker than that of the opposite arm.

As the case was evidently one of false circumscribed aneurism, combined with aneurismal varix, and was increasing, I recommended him to undergo an operation for its cure, in which opinion Dr. J. R. Barton, who afterwards examined it, coincided. To this, however, the patient was averse, and I heard nothing more of him till the 16th of June, when I was again consulted, and found that he had been making use of strong and well-applied pressure by means of a spring truss from the time I first saw him, and finding this painful and the tumor still augmenting, was now anxious to undergo the operation.

This was done on the 17th. The artery being compressed in the arm, the skin was divided over the tumor in its whole extent, without, however, opening the vein. The sac and dilated vein were then fully exposed by dissection as well as the artery, and ligatures were passed under the latter immediately above and below the sac. After careful examination to see that the ligatures surrounded the artery alone, these were secured—the lower one first. All pulsation in the part immediately ceased. The edges of the wound were drawn into apposition by adhesive plaster, and the patient was put to bed with the limb extended on a pillow.

On the 20th, pulsation could be felt in the radial artery.

On the 27th, a return of the thrill in the vein was detected.

Early on the morning of the 29th, he was awoke out of a sound sleep by hemorrhage from the arm, which, when I reached him a half hour after its occurrence, had been checked by a professional gentleman in the neighborhood by the application of a moderate degree of pressure; near a pint of florid blood was said to have been lost. Finding him easy, I left him without in any way disturbing the wound, but before mid-day was again summoned on account of a renewal of the bleeding. Upon removing the dressings, this was found to proceed from the opening through which the upper ligature passed. The parts around the wound presented a good appearance, no inflammation existing, and the divided parts having entirely united except at the points through which the ligature passed, neither of which were yet loose. Accurate examination of the brachial artery showed the extremity of the vessel above the upper ligature to be hard, and completely filled with coagulum, and this, in connection with the return of the thrill in the vein, which was now nearly as strong as it had originally been, and the direction from which the blood seemed to flow, led both my friend, Dr. E. Peace, who was present with me, and myself, to look upon the hemorrhage as proceeding from some opening in the upper part of the sac, and it was determined to lay open the vein and sac, first passing ligatures under the vein above and below, and afterwards tie up any vessels which should be found to give out blood. This was at once done, and a vessel from which arterial blood was poured out was secured at the bottom of the sac.

This proceeding was painful, but gave rise to no undue inflammation or fever. On the 3d of July, the ligature on the lower end of the artery (below the sac) was found to be loose and was removed. On the 7th, there was a return of the hemorrhage to the amount of several ounces, which was checked by lint and compression, and during the night other recurrences of bleeding took place which were each time restrained by pressure. On the 8th there was a renewal of the bleeding to such an extent as to necessitate the application of the tourniquet. All dressings were now removed preparatory to securing the artery high up in the arm, but the hemorrhage was found to have entirely ceased. It was now concluded to apply pure creasote freely to the wound, which was done by means of a camel's hair brush, and lint saturated with this substance was afterwards placed over the part without any other dressing, the extremity being extended on a pillow; the upper ligature was seen to be loose and was removed. On the 12th, the lint having become loosened by suppuration, was removed, and dry lint applied, which was changed every second day till the 25th, when cicatrization had taken place.

In the beginning of the month of October, I saw Mr. K., and found no trace of pulsation or tumor at the bend of the arm—the extremity had regained all its former power.

The preceding is an example of the affection first accurately described by Park and Physick, in which a false circumscribed aneurism exists in connection with aneurismal varix. The course of treatment to be pursued in either form of aneurismal varix does not seem to be yet determined by surgeons; some recommending simple ligature of the vessel above and below the sac without an opening into it, some the Hunterian method, some the ancient operation for aneurism, while others are inclined to rely upon compression alone.

Despite the superficial situation of the vessel, but few examples of the cure of false aneurisms at the bend of the arm by the latter method (compression) can be cited, except it be made immediately after the occurrence of the accident, when, if applied with judgment, it will generally prove successful. The mere application of pressure over or above the wound, in the way it is commonly made after venesection, will, however, almost invariably fail. Where the artery is wounded and compression is resorted to, a folded piece of lint should be placed over the wound, and a roller well and evenly applied to the member from the fingers to the shoulder, which will prevent the œdema and great pain so often resulting from the application of pressure at the point of injury alone. The limb after the bandaging should be kept in a state of perfect rest by means of an angular splint applied on the side of the arm, for a week or ten days after the accident, during the whole of which time the patient should be closely watched, and the bandage renewed as often as may be necessary.

Where, however, some time has elapsed after the production of the aneurism, compression is little to be relied on in its results, severe pain, excoriation, and even gangrene of the sac, having all repeatedly occurred from its application. Except when very recent, too, the Hunterian method is now commonly looked upon as inapplicable in these cases, and is abandoned, general experience proving that it fails where the affection is of any standing. The old operation of laying open the sac and securing the vessel above and below the wounded point, is still recommended by many estimable authors, is often performed, and, I believe, when the disease is of long standing, or of large size, is always the best and safest operation. In the case related, ligature of the vessel above and below the tumor, without meddling with its contents, was resorted to, inasmuch as the disease was only moderately developed, in order to avoid the increased danger attendant upon incision of the sac. The accidents to which the method exposes are well exemplified by the above case, and were such as will prevent my ever again having recourse to it, in other than the cases specified. In all the operations for varicose aneurism it is better, if possible, to avoid division of the vein; sometimes, however, this is impossible, and where divided, a thin ligature should be applied to it.

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